European Commission




EU Construction & Demolition Waste Management Protocol

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As part of contract Follow- up actions on the communication on sustainable competitiveness of the construction sector, this document was compiled on behalf of the European Commission

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1 Introduction

1.1 Aim of the Protocol

Based on volume, Construction and Demolition (C&D) waste is the largest waste stream in the EU – it represents about one third of all waste produced. Proper management of C&D waste and recycled materials – including the correct handling of hazardous waste - can have major benefits in terms of sustainability and the quality of life. But it can also provide major benefits for the EU construction and recycling industry, as it boosts demand for C&D recycled materials.

However, one of the common hurdles to recycling and re-using C&D waste in the EU is the lack of confidence in the quality of C&D recycled materials. There is also uncertainty about the potential health risk for workers using recycled C&D materials. This lack of confidence reduces and restricts the demand for C&D recycled materials, which inhibits the development of C&D waste management and recycling infrastructures in the EU.

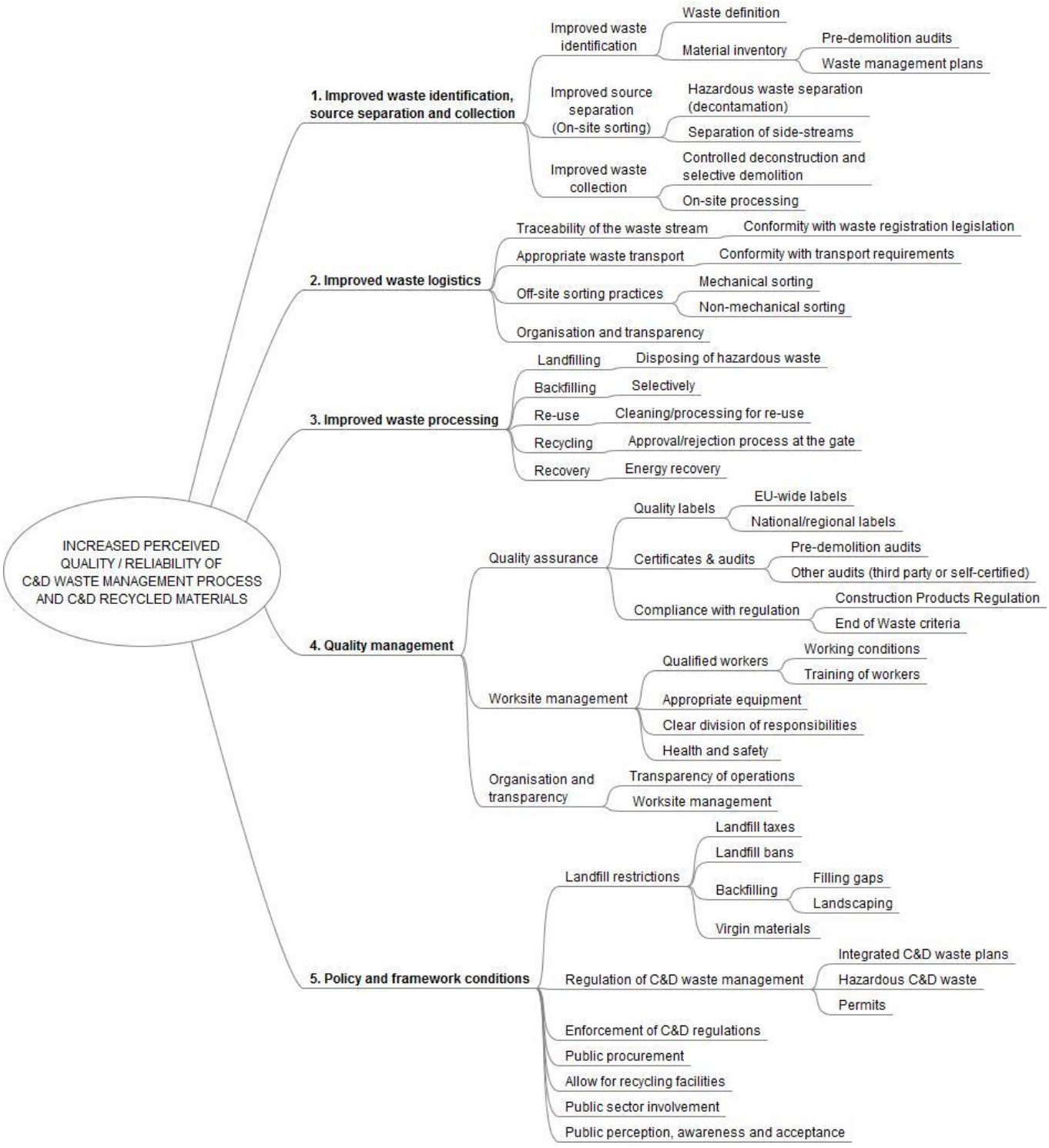
This Protocol fits within the Construction 2020 strategy[1], as well as the Communication on Resource Efficiency Opportunities in the Building Sector[2]. It is also part of the more recent and ambitious Circular Economy Package that the European Commission has presented[3], which includes revised legislative proposals on waste to stimulate Europe's transition towards a circular economy to boost global competitiveness, foster sustainable economic growth and generate new jobs. The proposed actions will contribute to reaching the Waste Framework Directive[4] target of 70% of C&D waste being recycled by 2020, closing the loop of product lifecycles through greater recycling and re-use, and bring benefits for both the environment and the economy. And more is currently done at local, regional, national and EU levels.[5]

The overall aim of this Protocol is to increase confidence in the C&D waste management process and the trust in the quality of C&D recycled materials. This will be achieved by:

a) Improved waste identification, source separation and collection;
b) Improved waste logistics;
c) Improved waste processing;
d) Quality management;
e) Appropriate policy and framework conditions.

[1] Strategy for the Sustainable competitiveness of the construction sector and its enterprises, COM (2012) 433, http://eur-lex.europa.eu/procedure/EN/201859
[2] COM (2014) 445 final, http://ec.europa.eu/environment/eussd/pdf/SustainableBuildingsCommunication.pdf
[3] Adopted 2nd December 2015, http://ec.europa.eu/environment/circular-economy/index_en.htm
[4] Directive 2008/98/EC on waste (Waste Framework Directive), http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0098
[5] For example, the development of the EMAS Sectoral Reference Documents on Best Environmental Management Practices for the Waste Management Sector (addressing among others Construction and Demolition Waste) and for the Construction Sector. http://susproc.jrc.ec.europa.eu/activities/emas/index.html

Figure 1 **The objectives and actions tree of the EU C&D Waste Management Protocol**



Wider benefits of the Protocol include:

- Increased demand for C&D recycled materials;
- The promotion of (new) business activities and players in the waste infrastructure sector;
- Increased cooperation along the C&D waste value chain;
- Progress towards meeting C&D waste targets;
- Progress towards harmonised EU markets for C&D recycled materials (where appropriate);
- The generation of reliable C&D waste statistics across the EU;
- Reduced environmental impacts and contribution to resource efficiency.

The Protocol has the following **target groups** of stakeholders:

- Industry practitioners; construction sector (including renovation companies and demolition contractors), construction product manufacturers, waste treatment, transport and logistics as well as recycling companies;
- Public authorities at local, regional, national and EU levels;
- Quality certification bodies for buildings and infrastructure;
- Clients of C&D recycled materials.

The **scope** of the Protocol includes waste from construction, renovation and demolition works. It excludes, however, the design phase, as well as excavating and dredging soils. The Protocol covers all components of the C&D waste management chain, apart from waste prevention.

With regard to **geographic coverage,** this Protocol has been developed for application in all 28 Member States of the European Union. It includes good practice from across the EU that can be sources of inspiration for both policy makers and practitioners.

1.2 Principles of the Protocol

The following principles will be taken into account for implementing all components of the Protocol across the C&D waste management chain. They should help to address issues that are encountered along the way.

Principle 1: Market-based and promoting competitiveness

This Protocol is market-based, and takes full account of the costs and benefits (including environmental ones) of C&D waste management. It is voluntary in nature.

Principle 2: Ownership by practitioners and acceptance and support from policy makers

The Protocol should be recognised and used by a group of practitioners and policy makers as widely as possible.

Principle 3: Transparency and traceability throughout the C&D waste management process

Transparency of what happens with the waste needs to be assured throughout all phases of the C&D waste management process. This will contribute to confidence in the recycled products. Therefore traceability is important.

Principle 4: Promoting certification and audits throughout the entire process (enforceability)

The ‘weakest link’ principle means that efforts to increase quality and confidence are only worthwhile if they are made along the complete waste management chain. In order to assure a certain minimum level of quality along the entire waste management process, auditing and

certification are important tools for increasing quality and confidence in C&D recycled materials. The Protocol focuses both on processes and products thereof.

Principle 5: No need to reinvent the wheel

The Protocol builds on existing standards, guidelines, protocols, best practices and certification schemes, notably the harmonised structure set in place in or by means of the CPR (Construction Products Regulation (EU) No 305/2011[6]). The Protocol is based on the highest common denominators that can be found today. In addition, it will use the findings from a wide range of studies and ongoing processes[7].

Principle 6: Location

Local circumstances including the scale and the surroundings of the project drastically influence the potential of C&D waste management, and it is crucial to acknowledge and respect this diversity. Above all, proximity matters and therefore the difference in potential between urban and rural settings needs to be fully acknowledged: feasibility of C&D waste recycling is much higher in areas with higher population density. Geographic diversity (such as mountainous or not) and types of construction need to be accounted for as well.

Principle 7: Respecting environmental, health and safety rules and standards

There is no point in promoting C&D recycling or re-use if this comes at the cost of the environment, health or safety. The Protocol builds on existing standards such as ISO14001 for the environment, OSHAS18001 for safety and other CEN standards[8] that have already been developed in the sector. It also promotes the uptake within the sector of the EU Eco-management and Audit Scheme (EMAS) as a tool to evaluate, report and improve the environmental performance of organisations.

Principle 8: Data collection and generation throughout the C&D waste management process

The collection and generation of data and statistics for better policies and practices needs to be improved, also allowing for comparison between Member States. This requires tracking and tracing of all C&D waste generated. For the purpose of data comparability, it is important to use common names for the different C&D waste fractions[9].

1.3 Structure of the Protocol and its preparation

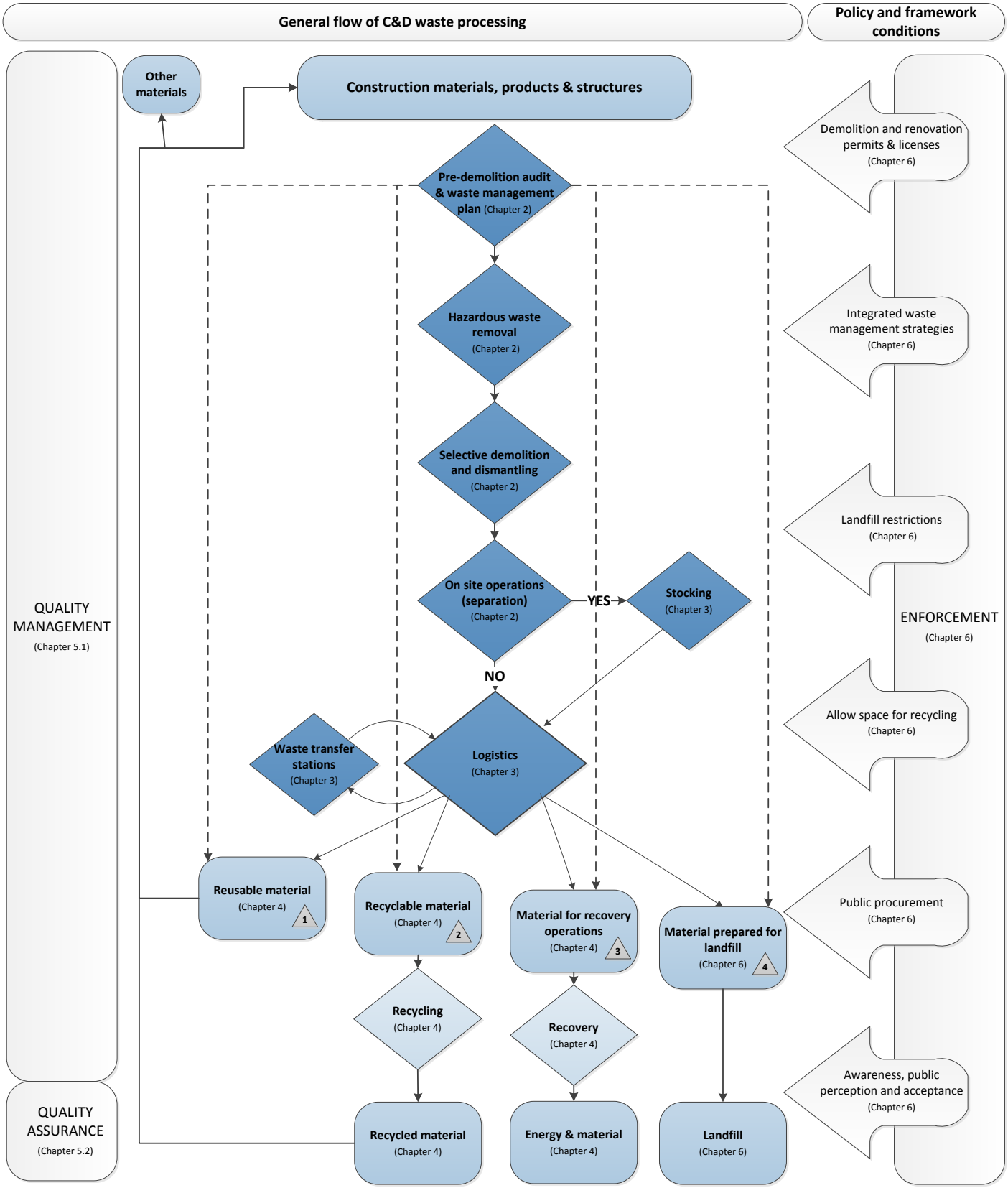
The Protocol consists of 5 **components**, all of which contribute to the overall aim. The first three are based on the C&D waste management chain and two are of a horizontal nature:

a. Waste identification, source separation and collection;
b. Waste logistics;
c. Waste processing;
d. Quality management;
e. Policy and framework conditions.

[6] Construction Products Regulation (EU) No 305/2011http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32011R0305
[7] Such as the development of EMAS Sectoral Reference Documents on Best Environmental Management Practice for the Waste Management Sector and for the Construction Sector carried out under the EU regulation (EC) No 1221/2009, http://susproc.jrc.ec.europa.eu/activities/emas, http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2016.104.01.0027.01.ENG
[8] European Committee for Standardisation, http://standards.cen.eu/dyn/www/f?p=CENWEB:105::RESET::::
[9] European List of Waste (Commission Decision 2000/532/EC), http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32000D0532

Figure 2 visualises a general flow of C&D waste processing and its relation to the policy and framework conditions. The chart can be specified depending on the C&D material and situation.

Figure 2 **General flow of C&D waste processing (triangles represent the waste hierarchy, with nr. 1 being the most desirable)**



Source: Eurogypsum modified by Ecorys

The Protocol has been developed through the following **preparation process**:

The initiative was launched by the European Commission (EC) – the Directorate-General (DG)) for Internal Market, Industry, Entrepreneurship and SMEs, but the project is built on the active participation and contribution from industry and national government officials based on the tripartite principle of the Construction 2020 initiative[10]. Industry experts have played a major role in developing the Protocol, supported by the feedback, input and guidance from public sector officials. The EC has implemented the process supported by a contractor[11].

The preparation process has been carried out through two **Task Forces** lead by the Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, that each had the responsibility for developing the Protocol in their respective fields:

1. **Task Force 1 on Quality Recycling, Building Confidence**, mostly staffed by a wide range of industry professionals across the EU-28, covering representatives from Construction services (contractors, demolition/deconstruction, architecture etc.); Construction products (concrete/cement producers, plasterboard producers, etc.); Waste management (recycling, waste logistics etc.).
2. **Task Force 2 on Setting conducive policy and framework conditions**, consisting of Member State government representatives (from both national and regional levels), EU level stakeholder organisations and EC officials including those from Directorate-General's involved (for example DG Environment and DG Research and Innovation).

These Task forces came together during 5 meetings held in the period September 2015 – May 2016, supplemented by 2 virtual meetings, and concluded by a validation workshop in June 2016.

Finally, this EU Construction & Demolition Waste Management Protocol has been developed at a particular point in time. It should be open to revision, taking into account new technological and policy developments and practices.

[10] The Construction 2020 initiative is based on the EC Strategy for the Sustainable competitiveness of the construction sector and its enterprises (COM(2012)433 final), http://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A52009DC0433

[11] Ecorys in its capacity as support provider to the Construction 2020 secretariat.

2 Waste identification, source separation and collection

Improved waste identification, separation and collection at source are at the start of the C&D waste management process. Improved waste identification requires clear and unambiguous definitions; it also requires good-quality pre-demolition audits and waste management plans to be prepared and executed. A crucial part of the source separation is the elimination of hazardous waste, as well as the separation of materials that hamper recycling, including fixation materials. Improved collection of goods for re-use and recycling requires selective demolition and appropriate on-site operations as well.

2.1 Definitions and terms

1. **Clear and unambiguous definitions** are a crucial starting point and it is important to pay proper attention to the exact use of wording. The field of C&D waste management is fraught with different terms and concepts, due to the large variety of perspectives and stakeholders involved. As C&D waste management is primarily a local activity, strong differences in terminology exist between Member States as well. Annex A provides an overview of the definitions and terms used in this Protocol.

2.2 Improve waste identification

PRE-DEMOLITION AUDITS ('WHAT MATERIALS?')[12]

2. Any demolition, renovation or construction project needs to be **well planned and managed**. This brings about important cost benefits, as well as environmental and health benefits and carbon-savings. Such preparatory activities are particularly crucial for larger buildings.

3. A **pre-demolition audit (or waste management audit)** is to be carried out before any renovation or demolition project and for any materials to be re-used or recycled, as well as for hazardous waste. It helps to identify the C&D waste generated, implement proper deconstruction, and to specify dismantling and demolition practices. The actions based on the audit will ensure the safety of workers and lead to an increase in the quality and quantity of recycled products. It will also help to increase the amount of materials to be re-used close to or at the construction site. Additionally, the implementation of these audits can help clients with setting performance levels for demolition contractors, support a site-specific waste management plan, demonstrate environmental credentials, increase material and labour efficiency, reduce waste and maximise profit.[13]

4. Public authorities should decide upon the **threshold** for pre-demolition audits (for example in Austria two limits for pre-demolition audits exist: 100 tons and 3.500 m³ of estimated C&D waste produced).

[12] For the overall list of waste fractions arising during renovation and demolition see the Swedish Resource and waste guidelines during construction and demolition, Appendix 1-4: https://publikationer.sverigesbyggindustrier.se/en/resource-and-waste-guidelines-during-con__1094

[13] BRE Smartwaste, 2015, https://www.smartwaste.co.uk/page.jsp?id=30

5. A pre-demolition audit **consists of two parts**:
   a) Information collected: Identification of all waste materials that will be generated during the demolition with specification of the quantity, the quality and location in the building or civil infrastructure. All materials should be identified and a good estimation on the quantity to be collected should be given;
   b) Information about:
      - which materials should (mandatory) be separated at source (such as hazardous waste);
      - which materials can/cannot be re-used or recycled;
      - give information about how the waste (non-hazardous and hazardous) will be managed and the recycling possibilities.

6. Hence, a pre-demolition audit **takes full account of local markets for C&D waste and re-used and recycled materials**, including the available capacity of recycling installations.

7. A good pre-demolition audit is carried out by a **qualified expert** with appropriate knowledge about building materials, building techniques and building history. A qualified expert needs to be familiar with demolition techniques, waste treatment and processing as well as with (local) markets.

WASTE MANAGEMENT PLANS ('HOW ?')

8. Whilst the pre-demolition audit focuses on the products ('what'), a process-oriented **waste management plan ('how') is to be prepared** if any material from construction, renovation or demolition operations is to be re-used or recycled. A good waste management plan contains information about how the different steps of the demolition will be performed, by whom they will be performed, which materials will be collected selectively at source, where and how they will be transported, what will be the recycling, re-use or final treatment and how to follow up. Such a plan also covers how to address safety and security issues, as well as how to limit environmental impacts, including leaching and dust. In the plan it should be stated how both the non-hazardous and hazardous waste will be managed.

Demolition site. Source: VERAS

9. It is crucial that **demolition activities are carried out according to a plan**. After the demolition, the contractor should make an overview about what has really been collected at source and to where the waste materials have been transported (for re-use, for pre-treatment (sorting), for recycling, for incineration, landfilling, …). This information should be (1) checked with what was foreseen in the inventory, and (2) provided to the authorities.

For best practice examples see: Box 1: The French example of diagnosis of waste from demolition and refurbishment of buildings;
Box 2: The Dutch certification scheme for demolition processes *(BRL SVMS-007) in Annex D.*

10. It is recommended that this whole process is **supervised** by a local authority or by an independent third party, for example by an external waste management organisation through:
    - An "inter-demolition" control at site by a third party, after removal of the hazardous waste;
    - After the fact: on the basis of sampling controls carried out by the same independent third party who has prepared the pre-demolition audit;

- After the fact: a desk control to check what happened with all of the non-recyclable or non-reusable materials (a check of transportation documents, certificates of treatment or waste processing, etc.).

2.3 Improve source separation

11. A key aspect of proper waste management is to **keep materials separated**. The better inert C&D waste is separated, the more effective recycling will be and the higher the quality of recycled aggregates and materials. However, the degree of separation depends strongly on the options available at the site (e.g. space and labour) and on the costs and revenues of separated materials. Such separation can be challenging: buildings have become increasingly complex and this has implications for demolition works[14]. Furthermore, over the last few decades, an increasing amount of materials have been glued and the use of composite materials has extended as well.

Source separation at a demolition site, Source: UEPG

12. When starting C&D waste recycling, one typically **starts with the easiest materials** for which secondary markets already exist. In many cases this will be the inert fraction, but in some Member States it can also be metals or wood. However, every situation is different.

13. **A distinction needs to be made between the materials with a view of their treatment options** (see Chapter 4), such as:
    - cleaning for re-use (for example soil);
    - re-use (for ex. structural steel, metal sheet and tiles);
    - recycling in the same application (for ex. metals, paper, glass, cardboard and asphalt);
    - recycling in another application (for ex. aggregates, wood for particleboard manufacturing);
    - incineration (for ex. wood, plastics, paper packaging);
    - disposal (for ex. hazardous waste).

14. Source separation involves the **following types of operation**:
    - hazardous waste separation;
    - deconstruction (dismantling including separation of side streams and fixation materials);
    - separation of fixation materials, and;
    - structural or mechanical demolition.

[14] See for example OVAM (in Dutch), http://www.ovam.be/afval-materialen/specifieke-afvalstromen-materiaalkringlopen/materiaalbewust-bouwen-in-kringlopen/selectief-slopen-ontmantelen

HAZARDOUS WASTE REMOVAL (DECONTAMINATION)

15. Proper **decontamination needs to be done** for a number of reasons other than reuse or recycling: to protect the environment; to protect the health of workers; to protect the health of people living in the surroundings of the site, and for safety reasons. Typical hazardous waste products from construction, renovation or demolition works are asbestos, tar, radioactive waste, PCBs, lead, electrical components containing mercury[15], insulation materials containing hazardous substances etc.

Asbestos marked pipe, Source: UEPG

16. **Decontamination is necessary so that hazardous particles will not contaminate the recyclable materials.** Even if it is present in a very small proportion of the total waste materials, the possible presence of hazardous waste materials can reduce markets' confidence in the recycled waste materials drastically and therefore the perceived quality of the recycled products.

17. Hazardous waste therefore **needs to be removed correctly and systematically prior to demolition** as it can be 'explosive', 'oxidising', 'toxic', 'harmful', 'corrosive', 'irritating', 'carcinogenic' or 'infectious'. The waste management plan needs to foresee which actions are to be taken if unexpected hazardous waste materials are found.

18. Throughout the process, hazardous waste removal needs to **comply with existing (national) level legislation.** Depending on the Member State, the treatment of some of these waste types (e.g. asbestos) is regulated, whilst this is less so for others (e.g. PCB's and PAH's).[16] Annex C provides more information on hazardous waste.

For best practice example see Box 3: List of C&D materials that need to be removed from the building before demolition – example of Austrian standard ÖNORM B3151 in Annex D.

SELECTIVE DEMOLITION AND DISMANTLING

19. **Main waste streams, including inert waste from buildings or civil infrastructures should be treated separately** (e.g. concrete, bricks, masonry, tiles and ceramics). For the use of recycled materials in high grade applications, a more selective demolition can be required (such as separate collection/dismantling of the concrete and masonry).

20. **An increasingly wide range of materials need to be considered for (manual) dismantling**, to enable re-use, including techniques such as stripping (before demolition) and scavenging (after demolition). Examples include glass, marble fireplaces, precious woods such as walnut and oak, traditional sanitary ware, central heating boilers, water heaters, radiators[17], window frames, lamps and lamp-frames, steel structures, and cladding materials. Other materials which are to be considered for re-use or recycling include gypsum[18], insulation foam, concrete, and mineral wool and glass wool. Such operations allow for subsequent re-use and recycling of the materials themselves, but also aim at the purification of the main stream (i.e. inert waste destined for the

[15] Kvicksilver i tekniska varor och produkter – Naturvårdsverket, https://www.naturvardsverket.se/Documents/publikationer/91-620-5279-9.pdf?pid=2929

[16] For example, PVC can contain high levels of phthalates that are now on the Candidate List of Substances of Very High Concern which includes candidate substances for possible inclusion in the Authorisation List of REACH, https://echa.europa.eu/addressing-chemicals-of-concern/authorisation/recommendation-for-inclusion-in-the-authorisation-list/authorisation-list, as well as heavy metal compounds used for stabilising the product. Foam insulation produced including CFC still contains high amounts of CFC and if not treated right they can evaporate into the air.

[17] JRC/DG ENV (2015) Best Environmental Management Practice of the Building and Construction Sector, http://susproc.jrc.ec.europa.eu/activities/emas

[18] Gypsum-to-gypsum project, www.gypsumtogypsum.org

production of recycled aggregates). Side-streams including fixation materials, like gypsum, can therefore compromise the quality of the C&D recycled material. Side-streams risk not being treated properly if there is no local/national regulation in place.

ON-SITE OPERATIONS

21. **Consider on-site operations** as they can offer cost advantages and reduce transport needs. However, decisions on such on-site preparation for re-use and recycling need to be taken on a case-by-case basis depending on the site characteristics like size of the site and proximity to green areas, residents and businesses. Such decisions need to take into account economic, environmental, social and health factors and risks. Such operations often require permits or licenses (see also Chapter 6.1).

For best practice example see:
Box 4: Gypsum to gypsum project (GtoG);
Box 5: Factors affecting recovery of materials in the demolition process in Annex D.

PACKAGING WASTE

22. **Packaging materials[19] brought onto construction sites should be minimised** as much as possible through optimisation of the supply chain, for example bulk deliveries, supplier take-back agreements etc. Any packaging waste arising on-site should be sorted as much as possible according to local waste collection practices, like plastics, wood, cardboard, metal. The correct assigning of waste codes to packaging waste is important (taking into account local specificities) when considering contaminated packaging, for example paint cans. Contamination can be reduced by minimizing the amount of hazardous waste. For example, paint cans should be empty and cleaned out as much as possible with a brush, and left with the lid off in order to dry any remaining residue[20]. Once this is done the cans are usually classified as non-hazardous waste and can be easily recycled.

DOCUMENTATION IS ESSENTIAL

23. Throughout the waste management cycle, monitoring is crucial: **all contractors need to have the necessary documentation, and real activities need to correspond to this**. This contributes to transparency and trust in the C&D waste management process.

[19] Packaging waste (waste classification code 15) is not C&D waste, although it is generated on construction sites.
[20] European Commission (2015): Study to develop a guidance document on the definition and classification of hazardous waste, http://ec.europa.eu/environment/waste/studies/pdf/definition%20classification.pdf

3 Waste logistics

3.1 Transparency, tracking and tracing

1. **Transparency needs to be assured throughout all phases of the C&D waste management process.** Traceability is important for building confidence in the products and processes, and to mitigate any negative environmental impacts.

For best practice example see Box 6: Mineral waste traceability in French construction industry in Annex D.

2. Proper management of C&D waste still presents a problem in the EU, and data on its treatment is partly missing.[21] Therefore it is necessary to **strengthen record keeping and traceability mechanisms through the establishment of electronic registries** especially for hazardous C&D waste in the Member States. Good practices already exist in this domain in some Member States.

For best practice example see Box 7: French Electronic Traceability System in the Annex D.

3. Registration of C&D waste constitutes a vital step for **tracking and traceability** and in order to register waste, it is necessary to know what types of C&D waste are expected. Therefore, a pre-demolition audit (Chapter 2) is of high importance. But equally important is to check *afterwards* that the waste has been processed according to plan, and that rules and regulations for the handling of these waste streams have been enforced.

For best practice example see Box 8: TRACIMAT – Belgian example of a C&D waste tracking in Annex D.

4. When registering C&D waste it is recommended to **use the European List of Waste**[22] in order to assure compatibility of data across the European Union (see Annex B).

3.2 Improve logistics

5. **Try to keep distances short**. Proximity of sorting and recycling plants is very important for C&D waste, which in case of bulky materials such as aggregates for construction (asphalt, concrete, etc.) cannot be transported by road over longer distances (usually maximum 35 km). Unless transported in large volumes by rail or waterway, longer distances are simply not economically attractive[23], while environmental benefits of recycling diminish over longer distances as well.

Truck transporting C&D waste,
Source: A2Conseils sprl

[21] Circular Economy package, http://ec.europa.eu/environment/circular-economy/index_en.htm
[22] Commission Decision 2000/532/EC on the European List of Waste, http://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:32000D0532
[23] The lighter and the more valuable C&D material is, the longer the affordable transport distance.

6. **Optimise the use of road networks and profit from appropriate information technology (IT)**. For example, tailor-made software exist that allows driving directions to be optimised for minimum fuel consumption.[24]

7. **Where possible, use waste transfer stations** (or collecting boxes) – they play an important role in the local waste management system, serving as the link between a local C&D waste collection point (a demolition site) and a final waste disposal facility. Facility sizes, ownership, and services offered vary significantly between transfer stations. Nevertheless, they all serve the same basic purpose: consolidate waste from multiple collection points. Occasionally, transfer stations also provide waste sorting and recycling services.[25] It is important to assure traceability of C&D materials also in the case of waste transfer stations.

8. **Guarantee the integrity of the materials from dismantling to recycling**. For example, in the case of glass recycling, the degree of cleanliness of the containers is crucial. This requires the necessary attention by the logistic organisation – such as the use of multi-use containers. As soon as glass comes into contact with concrete, stone or brick residues, it is no more suitable for recycling in a circular mode (re-melting).

3.3 Stockpiling potential and proper stocking

9. Re-use, recycling and recovery of C&D materials **requires proper stocking**.

10. **Stockpiling is advantageous especially for big demolition sites**, e.g. airports, industrial plants or housing blocks, but can also be set up in small projects. Stockpiling can only be done during limited amounts of time: 1 year before disposal and 3 years before recycling.[26] Stockpiling of IT equipment usually requires permits from a competent authority.

11. **Take precautionary measures that minimise risks.** C&D waste stockpiling can cause various emissions and risks (like pollution of water, leaching or run-off of contaminants and particulates; heat generation with potential to cause fire; generation of litter; dust, biogas and odour emissions etc.). However, precautionary measures exist: for example, the waste should be segregated and disposed in separate dedicated containers (see also the Australian Guideline for stockpile management).[27]

Container with asbestos waste, Source: A2Conseils sprl

12. **Manage the on-site risks,** which depends on the following factors[28]:
    - waste type and chemical and physical characteristics of the materials being stockpiled;
    - location and climate of the site;
    - hydrological and hydrogeological conditions including proximity to surface; and
    - ground waters, water quality and protected environmental values;

[24] GGB, http://gbbinc.com/products
[25] Recyclingportal.eu, http://www.recyclingportal.eu/artikel/22506.shtml
[26] Council Directive 1999/31/EC, http://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:31999L0031
[27] Ibid.
[28] Ibid.

- length of time materials will be stored;
- proposed management approach to the stockpiled materials, including safety aspects of guarding the site from unauthorised visitors like children.

13. Therefore, stocking and stockpiling should be conducted in an appropriate manner so that the risk of harm to human health and the environment is prevented or minimised. **Stocking and stockpiling must be undertaken only in suitable circumstances** for genuine and beneficial purposes.

4 Waste processing and treatment

4.1 A variety of waste processing and treatment options

1. **Following the waste hierarchy**[29] offers wide-reaching benefits in terms of resource efficiency, sustainability and cost savings. A wide range of waste processing and treatment options exist, and these are commonly known as preparation for re-use, recycling and material and energy recovery – in that order of priority. The actual choice of the waste management option differs from case to case, depending on regulatory requirements, as well as economic, environmental, technical, public health and other considerations.

2. **Non-inert materials and products need to be sorted depending on their economic value**. Metal has an established resale value, and there is significant demand for materials such as bricks and tiles as well.

3. However, **many materials need to be processed or treated on the basis of primarily environmental criteria**[30]. Hazardous waste always needs to be separated and disposed of according to the national regulations on hazardous waste.

4. **Hazardous waste should not be mixed with non-hazardous waste**. Some types of C&D waste are not hazardous in their original form, but during the demolition stage can become hazardous through their mixing, processing or disposal. They can also pollute non-hazardous materials and thus make them non-reusable/recyclable. A classic example is lead-based paint thrown onto a pile of bricks and concrete, turning the whole pile into hazardous waste.

Construction and demolition waste, Source: UEPG

4.2 Preparation for re-use

5. **Preparing for re-use is to be promoted** as it involves application with little or no processing. In theory, re-use offers even greater environmental advantages than recycling since environmental impacts associated with reprocessing do not arise. However, in practice this may not be easy always.

For best practice example see Box 9: Re-use of construction materials on a temporary construction site – example of the London 2012 Olympic Park in Annex D.

6. Reclamation rates for high-value materials, such as metals and hardwood timbers, have increased in the last years. In order to ensure high re-use rates, **a market for these materials needs to be created**. In order to create demand,

For best practice example see Box 10: OPALIS - online inventory of the professional sector in salvaged building materials around Brussels in Annex D.

[29] Directive 2008/98/EC on waste (Waste Framework Directive), http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0098

[30] JRC (2012): EMAS Best Environmental Management Practices, Sector Environmental Performance Indicators and Benchmarks of Excellence for the Building and Construction Sector, http://susproc.jrc.ec.europa.eu/activities/emas/documents/ConstructionSector.pdf

proof of satisfying quality is required. Usually it is the contractor that is responsible for the quality confirmation.

4.3 Recycling

7. **Sound planning of construction activities** and related waste management activities on construction sites are a prerequisite for high recycling rates and high-quality recycling products. Much of C&D waste is recycled for economic reasons, however recycling of materials such as concrete, wood, glass, gypsum drywall and asphalt shingles has benefits well beyond financial one's:[31] it results in greater job creation, reduced use of primary materials and reduced landfilling. Avoidance of landfilling also supports environmental protection, a smarter use of natural resources, energy savings, a net decrease in greenhouse gas emissions[32] and avoidance of excavations in (or exploitation of) rural/forest regions.

8. **Materials can either be recycled on-site into new construction resources or off-site at a recycling plant.** Typical materials recycled from building sites include metal, lumber, asphalt, pavement (from parking lots), concrete and other stony materials, ceramics (e.g. bricks, roof-tiles), roofing materials, corrugated cardboard and wallboard.[33]

For best practice example see Box 11: Recycling of PVC; Box 12: Wood recycling into wood-based panels; Box 13: Recycling and re-use of mineral wool in Annex D.

9. **C&D waste recycling needs to be promoted particularly in densely populated areas**, where supply and demand are geographically close, resulting in shorter transport distances than for the supply of primary materials, such as in the case of aggregates.[34]

For best practice example see Box 14: The Netherlands history of recycling C&D waste; Box 15: Swedish guidelines for resource- and waste handling in construction and demolition in Annex D.

C&D waste recycling plant, Source: FIR

Recycled granular aggregate, Source: ANPAR

[31] CDRA White Paper (2015): The Benefits of Construction and Demolition Materials Recycling in the United States, http://www.cdrecycling.org/assets/docs/exec%20summary_cd%20recycling%20impact%20white%20paper.pdf
[32] Ibid.
[33] Environmental Protection Agency: http://www3.epa.gov/epawaste/conserve/imr/cdm/pubs/brochure.pdf
[34] Pacheco-Torgal, Tam, Labrincha, Ding and de Brito, Handbook of recycled concrete and demolition waste, 2013, Woodhead Publishing Limited (ISBN 978-0-85709-682-1), p.62

4.4 Material and energy recovery

MATERIAL RECOVERY

10. **Backfilling is one way to re-use non-hazardous CDW**, specifically in public and earthmoving works. It can help raise awareness to collect, transport and process waste. It can be useful in particular situations, when re-use or recycling into higher quality application is not possible, and can be applied in the context of the waste hierarchy.

11. However, **use backfilling as a last resort option** as it has drawbacks: it can undermine the incentives to re-use and recycle in higher value applications. C&D waste should be treated before being backfilled, in order to avoid unwanted environmental effects, such as substances leaching into the groundwater.

For best practice example see Box 16: Circular Economy package on backfilling;
Box 17: Bulgarian Ordinance on C&D waste used for backfilling in Annex D.

ENERGY RECOVERY

12. **Consider all possibilities for recovery as substitute fuel** - so-called Refuse Derived Fuels (RDF).[35] The following C&D waste streams are of interest to be used as RDF if the logistics for collection and distribution of it exist:
    - contaminated wood and wood-based products that are not suitable for re-use or recycling;
    - plastics;
    - organic insulation (thermal insulation, sound insulation) materials;
    - bitumen based waterproofing membranes.

13. **Make use of the available technologies.** Several technologies have been developed for the processing (shredding) of C&D waste for RDF sorting[36] and production[37]. In some countries (for ex., Austria[1], Pakistan) there are guidelines for processing and using refuse derived fuel (RDF) in the cement industry.[38] In the framework of the Cement Sustainability Initiative (CSI), many other guidelines for RDF-use in the cement industry have been published.[39]

[35] WtERT, http://www.wtert.eu/default.asp?Menue=13&ShowDok=49
[36] Magsep, http://www.magsep.com/optical-sorting-applications/municipal-solid-waste-msw-sorting/refuse-derived-fuel-rdf-sorting/
[37] TANA, http://www.tana.fi/recycling-processes/construction-and-demolition-waste
[38] Government of Pakistan Pakistan Environmental Protection Agency (Ministry of Climate Change), http://environment.gov.pk/EA-GLines/RDF-GuideLines.pdf
[39] World Business Council for Sustainable Development, http://www.wbcsdcement.org/pdf/Waste%20management%20solutions%20by%20the%20cement%20industry.pdf

5 Quality management and assurance

Quality management is a crucial step towards increasing the confidence in the C&D waste management processes and the trust in the quality of C&D recycled materials. The qualitative value of recycled construction materials is based on their environmental features and on their technical performance. Appropriate quality management procedures and protocols allow suppliers to control and secure their processes and the quality of products. Thus, there is a need to promote quality assurance of the primary processes (from demolition site to waste logistics and waste processing) (section 5.1), as well the provision of reliable and accurate information about the performance of the recycled or re-used products (section 5.2).

To further develop the market for recycled construction materials, the traceability and tracking of waste flows is essential. Tracking and tracing procedures (Chapter 3), can help to build trust in secondary construction materials and can be considered as an essential part of quality management.

5.1 Quality of the primary process

1. In general, **quality management and quality assurance becomes more important if recycled construction materials are used in 1) high-end applications and 2) in large volumes** (high recycled content). Quality management is vital throughout every stage of the process, but at some stages and for some materials, good quality management is even more important. Recycled construction materials, like unbound recycled aggregates, potentially can release substances in the environment. Materials, like asbestos, can have potential health impacts on workers in the construction, demolition and recycling sectors. Other materials derived from C&D waste are used as raw material for subsequent production processes, such as recovered plastics and wood.

2. Environmentally sound application of recycled aggregates can be secured by **introducing quality management checks and tools** at all stages of the recycling process: 1) at demolition sites; 2) during waste transportation and transfer; and 3) at C&D waste recycling sites (see Table 1). For all these stages good documentation and adequate traceability procedures should be put in place.

Table 1 **Quality management steps in different stages of the recycling route**

Waste identification, source separation and collection	Waste transportation	Waste processing and treatment
• Pre-demolition audit (a/o asbestos detection); • Selective demolition; • Identification and separation of hazardous waste.	• Safe transport; • Special provisions/declaration for hazardous waste; • Identification form; • Registered or approved transporter/carrier.	• Waste acceptance (at recycling/landfilling site); • Input control (for exemple asbestos protocol); • Factory production control (addressing essential characteristics of products); • Acceptance criteria (such as for raw materials used for waste-derived products manufacturing); • Frequency of the sampling; • Identification of the recycled aggregates used in a specific product/infrastructure (delivery note) (final tests of the waste derived products clearly documented).

Source: FIR, 2016, modified by Ecorys

3. **Make use of existing general quality management schemes** such as ISO 9000, and environmental management systems such as ISO 14001 and EMAS. They are all important mechanisms to guarantee the quality of the quality and environment management process (see Table 1).

QUALITY MANAGEMENT AT THE WASTE IDENTIFICATION, SOURCE SEPARATION AND COLLECTION STAGES[40]

4. The first steps in the supply chain of recycled building materials are essential. Quality control during **pre-demolition and demolition should be taken seriously**, both in terms of occupational safety and recyclability of the C&D waste materials. If hazardous substances, such as asbestos and heavy metals are not removed properly and building materials are not separated at the demolition site, entire waste streams can potentially get contaminated. In several Member States guidelines and protocols exist, for instance, for the identification and removal of asbestos, tar and other hazardous substances[41] (see also Chapter 2.3).

For best practice example see Box 18: EMAS - Best Environmental Management Practice in the Waste Management Sector; Box 19: QUALIRECYCLE BTP, an audit designed for C&D waste management companies in Annex D.

5. Key quality management steps in the demolition stage consist of a pre-demolition audit, on-site reporting and a final report for the recycling plant. Some Member States have voluntary quality management certification schemes for demolition projects and processes. For example in the Netherlands, most contractors are certified by the demolition process scheme BRL SVMS-007 which is controlled by third parties and the Council of Accreditation. Most important is that environmentally sound demolition and safety for the workers and surroundings are assured.[42]

6. **Key quality management steps during new construction include identification of expected waste and amounts for preparation of a waste management plan.** Planning for different types of waste during different stages of the construction process is very important and will reduce costs for further handling. Steps must be taken for safe handling and storage of any hazardous waste. In order to reduce amounts of hazardous waste, care should be taken at the product choice stage to reduce the amount of materials containing hazardous substances. This will also ensure a better indoor environment. Follow-up and feedback during the whole construction process will ensure correct management and allow for corrections along the way.

QUALITY MANAGEMENT DURING C&D WASTE TRANSPORT

7. C&D waste should be **transported safely and legally** without causing any harm to the environment or risking workers' health.

8. **Before transfer, the contractor should verify if the waste is hazardous or not and provide appropriate transport.** Hazardous waste should be kept separate from other waste, safely stored, clearly labelled containers, out of reach for unauthorised persons. Moreover, the contractor should prove that the hazardous C&D waste is transferred to a facility that is authorised to receive it.

[40] It applies only to demolition and renovation
[41] Sveriges Byggindustrier, 2016, https://publikationer.sverigesbyggindustrier.se/sv/energi--miljo/resurs--och-avfallshantering-vid-byggand__860
[42] Veligslopen, http://www.veiligslopen.nl/en/home/

QUALITY MANAGEMENT DURING C&D WASTE PROCESSING AND TREATMENT

9. Quality management at the **recycling site consists of several steps to be taken by the recycler.** Inert waste destined for recycling is accepted at crushing facilities where strict acceptance protocols apply such as checking of the waste shipment and accompanying material certificates or delivery notes. The recycling company ensures the good quality of input materials and the elimination of hazardous substances and impurities during the treatment process.

10. After the processing, **factory production control prescribes the frequency and types of sampling and testing** to ensure that all EU production is tested according to the same standards. When the final product is intended to be permanently incorporated into construction works, it must be tested according to a harmonised structure established in or by means of the CPR. This structure also comprises the choice of the systems for third party involvement. The best practice in quality management would consist of a self-control and a third party control by an accredited certification organisation.

11. **A systematic and sequenced working method reduces the environmental risks**: selective demolition-waste acceptance, factory production control, final testing. The risks of hazardous substances passing to the final product should be reduced from step to step if the process functions as intended. When it comes to construction products, testing methods are included in harmonised products standards and EADs (European Assessment Documents) under the CPR.

12. Many Member States also have more general quality management schemes which apply for all process steps, for instance **guidelines to make sure that employees work with good equipment and are skilled and trained.**

13. **In countries where end-of-waste criteria are in place, practitioners are encouraged to work with them.** The Waste Framework Directive invites Member States and industry to develop end-of-waste criteria for different waste materials, based on the criteria indicated in Article 6. Some countries and sectors have already developed these criteria; others have opted to not work with them. Stakeholders in the construction and demolition supply chain often indicate that end-of-waste criteria are a precondition for development of a market of secondary construction materials. The ambition of this Protocol is to just provide elements and building blocks to Member States and industry – allowing them to make the choices which fit the specific context.

5.2 Quality of products and product standards

14. In theory, there could be several ways to validate the quality of recycled materials, including certification, accreditation, labelling and marking. However, harmonised European standards that apply to primary materials also apply to recycled materials. C&D recycled materials must be assessed in accordance with requirements of European product standards, when covered by them.[43] This section looks at the rules and guidelines for placing recycled materials on the European market and related quality assurance instruments.

15. **Making use of existing European product standards.** The Construction Products Regulation (EU/305/2011, CPR) lays down harmonised rules for the marketing of construction products and provides tools to assess the performance of construction products. Construction products that are

[43] Construction products harmonised standards, http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32011R0305

covered by Harmonised European Standards (hENs) need a Declaration of Performance (DoP)[44] and have to be CE-marked to increase transparency.

16. **If these European product standards do not apply, make use of European Technical Assessments.** Products that are not (fully) covered by hENs can still be CE-marked with the use of European Technical Assessments (ETA) issued according to European Assessment Documents (EAD). The ETA document provides information about the performance of a construction product, to be declared in relation to its essential characteristics. This voluntary tool enables manufacturers to place recycled or re-used products on the EU market and allows them to declare specific information about the performance of their products. There are already examples of using these tools for processed demolition waste, mainly for recycled aggregates.

17. **In case European product standards or assessments do not apply, Quality Assurance schemes can be a useful additional tool.** In several Member States there are Quality Assurance schemes in place for specific products, like recycled aggregates. Such schemes often contain requirements concerning waste acceptance and environmental issues. When working with such national or regional schemes it is important to secure that:

For best practice example see Box 20: Standards for recycled wood in Annex D.

- There is no conflict with the European harmonised approach;
- No technical barriers to trade are invoked;
- Impacts on costs and administrative burden have been fully taken into account and where possible mitigated;
- Innovative companies are not put at a disadvantage compared to other companies.

[44] Excluding the exceptions provided for in Article 5 of the Construction Products Regulation

6 Policy and framework conditions

Successful C&D waste management as set out in this Protocol can only take place if the appropriate policy and framework conditions are in place. To achieve this, a dialogue between public and private actors in the field of C&D waste management is of the greatest importance. Whilst chapters 1 – 5 are targeting private actors and companies active in the field, this chapter is aimed at public sector representatives, active on local, regional and national levels. Key areas for public action are: a) An appropriate regulatory framework; b) Enforcement; 3) Right public procurement and incentives; 4) Awareness, public perception, and acceptance.

6.1 An appropriate regulatory framework

1. Proper regulation of C&D waste management requires that **ownership of the waste is clear**, in line with existing national legal frameworks and contractual terms between initial building and infrastructure owners, the (demolition) contractor, the intermediate holder (e.g. sorting operator), the final recycling operator and the end user of the recycled products. Such clarity is a condition for any transactions in the value chain – and attain confidence between all actors involved.

DEMOLITION AND RENOVATION PERMITS AND LICENSES

2. Local authorities are charged with **issuing demolition and renovation permits or licenses.** Such a permit allows local governments to promote and enforce the development of high-quality waste management plans based on pre-demolition audits. A post-demolition follow-up and evaluation process is very important. Requiring demolition reports after the works have been carried out allows local government to monitor whether such plans are being implemented effectively. Local authorities are encouraged to provide the demolition operator with incentives to climb higher in the waste hierarchy.

3. When designing a regulatory framework for C&D waste, it is important that the **administrative burden is kept to a minimum**.

INTEGRATED WASTE MANAGEMENT STRATEGIES

4. Local, regional or national governments could **set up integrated waste management strategies** that allow for C&D waste management to be promoted in a more systematic way. These plans and strategies are above all useful at regional or national level, and take full account of the specific situation.

For best practice example see Box 21: Integrated Waste Management Strategies in Annex D.

5. **Landfill restrictions are a prerequisite** for developing a market for C&D recycled materials. A mix of landfill bans and high landfill taxes could provide the necessary incentives. However, landfill restrictions always need to be accompanied by other measures, for example alternative facilities need to be available.

6. **Landfill bans can be a powerful instrument**. A progressive reduction of landfills, taking into account transition periods where necessary, is imperative to prevent detrimental impacts on human health and the environment and to ensure that economically valuable waste materials are gradually

and effectively recovered through proper waste management and applying the waste hierarchy.[45] Landfill restrictions are governed by EU law as well as Member State-specific legislations. The EU Landfill Directive[46] defines the acceptance criteria and procedures for different categories of waste (for ex., municipal waste, hazardous waste, non-hazardous waste and inert waste) and applies to all landfills defined as waste disposal sites for the deposit of waste onto or into land.[47] As part of landfill restrictions, it is important to establish a clear position vis-a-vis backfilling practices (see chapter 4.4).

7. Proper implementation of landfill bans requires a **strict and standardised acceptance policy**. Waste must be treated before being put in landfills; hazardous waste as defined by the Directive must be assigned to a hazardous waste landfill; landfill sites for inert waste must be used only for inert waste.

8. **Landfill taxes can be a differentiated and powerful** instrument. They aim to prevent that landfilling is the cheapest method of waste management, and are a flexible instrument set by Member States, regions or local authorities. These taxes need to be adjusted to the local situation (urban versus rural), nature of the waste (hazardous versus non-hazardous) as well as its condition (processed or not). The higher landfill taxes should be set for recyclable waste materials, whilst lower amounts should apply to inert non-recyclable waste and for waste such as asbestos for which landfilling is the only alternative.

9. **Hazardous waste treatment needs to be regulated in the waste treatment stage** through environmental regulation. These norms and standards envisage the elimination of hazardous substances and specifies the treatment to be applied to each of them. This is done, for example in Denmark, France, the Netherlands, Slovenia and Sweden.

For best practice example see Box 22: the Asbestos Abatement Programme in Poland (2009-2032) in Annex D.

10. **Taxes on virgin materials may be an option, depending on the local situation**. Member States or regions may consider formulating such taxes to provide price incentives to use recycled materials. However, they should be used prudently as such taxes increase the cost of construction without necessarily bringing the desired benefits to the environment or to the economy, especially if they lead to imports/transports of materials from countries or regions, where such taxes are not applied (or the rates are lower). A combination of policy instruments rather than a single one is preferable. Taxes on virgin materials and/or gravel taxes have been tested across Europe – and it is important to profit from the insights obtained.

For best practice example see Box 23: Decentralised taxes on sand, gravel and rock – the case of Italy in Annex D.

11. It is recommended that revenues arising from **landfill taxes are earmarked** and used for tasks that directly promote and support waste management policies and practices (e.g. decontaminating sites, operate public waste management authorities, subsidize C&D recycled materials). Such revenues are under no circumstance to flow back to the general state budget.

[45] COM(2015)594 final, Proposal for a Directive of the European Parliament and of the Council amending Directive 1999/31/EC on the landfill of waste, p.8, http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52016AE0042
[46] Council Directive 1999/31/EC, http://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:31999L0031
[47] In this context, excavated soils/rocks need to be separated as well. However as they are naturally occurring materials they are not considered in the scope of this Protocol.

ALLOW SPACE FOR RECYCLING

12. The available C&D recycling capacity is crucial for promoting C&D waste management. The feasibility of recycling is highest in densely populated and urbanised areas. However, this requires that space is reserved and that **permits are issued to build such facilities in appropriate locations** close to the urban areas – but this is not always the case.

C&D waste recycling plant, Source: ANPAR

13. **Public authorities in general and municipalities in particular have several roles to play**:
a) Estimate the required capacity in a given territory (based on integrated waste management plans and strategies); b) Design a framework for recycling, including the correct financial/economic incentives; c) Review proposals for site selection for facilities and issue permits based on all the considerations above; d) Address public perceptions with the aim to open mind-sets and overcome 'Not in my Backyard (NIMBY)' attitudes; e) Enforce the scheme by monitoring the correct use and implementation of permits; f) Take corrective measures where required (like giving renovation companies access to container parks to deliver glass waste; it is an efficient way to promote the recycling of glass from the renovation of private buildings, with limited logistics costs).

14. If there is a shortage of permanent recycling facilities, **temporary recycling installations and on-site recycling can help as well.** Some materials of higher value (for ex., plastics, ceramics, glass, gypsum, wood and metal) could be transported further away. Building waiting systems can be part of the solution as well.

15. As part of such permits or licenses, **local authorities also need to form a view on the use of mobile recycling plants (or mobile crushers).** Mobile recycling plants are specific to inert C&D waste, e.g. concrete and bricks, but also asphalt. Advantages of mobile recycling plants can be reduced transportation costs, and direct on-site access to the recycled materials. However, factors to consider when deciding about permits for such mobile installations include[48]:
    a) The complexity of the feed material as mobile plants can be used only for crushing and magnetic separation;
    b) Environmental and health aspects – including dust, noise, vibrations, leaching, accident risks;
    c) The neighbourhood perspective – distance to residential areas (dust, noise, vibrations, accidents);
    d) Emissions – mobile recycling plants are typically diesel-fuelled, whilst fixed installations run on electricity, which is associated with lower emissions[49].

    Again, the consideration between processing on-site (mobile) or at a stationary plant depends on the situation. Irrespective of the choice between mobile or stationary recycling plants, the quality of aggregates produced needs to be of similarly high quality. In addition, recycling plants should fulfil all requirements related to environmental-, health- and workers safety legislation.

[48] Pacheco-Torgal, Tam, Labrincha, Ding and de Brito, Handbook of recycled concrete and demolition waste, 2013, Woodhead Publishing Limited (ISBN 978-0-85709-682-1), p. 122, p.212 .
[49] It depends on the fuel used in the power station generating electricity.

6.2 Enforcement is key

ENFORCEMENT OF LANDFILL RESTRICTIONS

16. Enforcement is primarily the responsibility of local and/or regional government, and the **impartiality** of those involved (including politicians, civil servants, and police force) needs to be secured.

17. Local government needs to **manage complaints about illegal dumping** actively. This includes thorough investigations and follow-up of any such reporting.

18. **Proportional sanctions for illegal activities need to be imposed**, wherever they occur along the value chain of C&D waste (from illegal landfilling through waste dumping). They need to be set at high levels to act as deterrents, especially when hazardous waste is concerned.

19. In case enforcement is not sufficiently effective - particularly **hazardous waste legislation** in terms of the associated inherent dangers and risks - **higher government levels** (regional, national) need to step in and combine this with correctional measures targeting the local authorities involved.

A SPECIAL WORD ABOUT ENFORCEMENT OF HAZARDOUS WASTE

20. Hazardous waste needs to be addressed systematically in all stages of C&D waste processing. **Governments should adopt concrete actions to enforce existing legislation.** This needs to be done at different stages in the waste management cycle: waste identification, collection and sorting, waste logistics and waste treatment.[50]

21. During waste identification, collection and sorting, **regulatory measures need to cover the necessity of conducting a pollutant investigation** in the form of a pre-demolition audit or a waste management plan, before the demolition takes place, and promote waste flow separation. This is the case in Austria, Luxembourg, Sweden and Finland, among others. A **hazardous waste register** can be imposed in some cases, as it is the case in Belgium.

For best practice example see Box 24: Recycled materials: REACH in Annex D.

22. In the area of hazardous waste, policies need to focus on the **banning of hazardous waste mixing**, as it is the case in Finland, Sweden and Hungary for example, or contain rules concerning the tracking and control of waste streams. In Sweden it is required to have a permit from regional authorities to be allowed to transport hazardous waste. In addition, for each transport a "transport document" has to be provided. In Finland and Romania, regulatory instruments are also in force for the transport of hazardous materials, notably through the need to procure a shipping document, while in the UK there are rules governing the movement of waste from production to disposal or recovery.

DOCUMENTATION IS ESSENTIAL

23. Throughout the waste management cycle, monitoring is crucial. Therefore it is essential that **all authorities have the necessary documentation**. This creates transparency and trust in the C&D waste management process.

[50] Source: case studies conducted in the framework of the Project on Resource Efficient Use of Mixed Wastes, http://ec.europa.eu/environment/waste/studies/mixed_waste.htm

6.3 Public procurement

24. **Authorities at all levels can provide incentives for promoting the use of C&D recycled materials.** The EC has identified the construction sector as a priority sector for green public procurement for a long time already.[51] It focuses on public expenditure; potential impact on the supply side; example setting for private or corporate consumers; political sensitivity; existence of relevant and easy-to-use criteria; market availability and economic efficiency. Raw materials that are typically covered include wood, aluminium, steel, concrete, glass as well as construction products such as windows, wall and floor coverings, heating and cooling equipment, operational and end-of-life aspects of buildings, maintenance services and on-site performance of works contracts. Green Public Procurement criteria have been published for use in office buildings and road construction[52]. These guidelines take a lifecycle approach that addresses not only the use of recycled materials, but also the ability to **design buildings for disassembly** - enabling high rates of re-use and recycling at the end-of-life.

25. Much else can be done at national and regional levels, too. As a first step, **standards for the use of recycled aggregates** should be put in place. Then, the demand for C&D recycled materials can be increased for instance through prescribing its use by law in **tendering documents** and subsequent **enforcement** of the provision. For example in Flanders region in Belgium, waste management plans and pre-demolition audits are part of contractual documents in public procurement.[53] In Bulgaria, the contracting entity in public procurement for design and construction works[54] by law[55] has to include a requirement for the use of recycled building materials in contractor selection criteria and in work contracts. In Sweden, the property owner has the right to specify the environmental criteria for public procurement. In the Netherlands, a voluntary, non-legally binding code has been established, which can be applied by contractors and customers in procurement procedures.[56] Recycled concrete that can be used in road works for instance, instead of fresh concrete, is one of the most commonly used C&D recycled materials. Again, the use of C&D aggregates depends on the **local context**, including characteristics of the local market as well as supply and demand for recycled materials. It can be useful to carry out an assessment to determine which is the most sustainable application of recycled aggregates[57]. For example in Flanders, there is a shortage of virgin materials and therefore a bigger incentive exists to recycle C&D waste.

For best practice example see Box 25: The French environmental assessment approach to waste in road engineering;
Box 26: Private and/or national systems for sustainable construction in Annex D.

6.4 Awareness, public perception and acceptance

26. **Authorities need to inform companies about the legal requirements** (made at local, regional, national or EU level) with regard to C&D waste management.[58] Upon request, advice should be given on how to comply with all legal requirements. For effective C&D waste management, local,

[51] Public Procurement for a better Environment, COM 2008 (400), p.7, http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2008:0400:FIN
[52] DG Environment, http://ec.europa.eu/environment/gpp/eu_gpp_criteria_en.htm
[53] OVAM, http://www.ovam.be/afval-materialen/specifieke-afvalstromen-materiaalkringlopen/materiaalbewust-bouwen-in-kringlopen/selectief-slopen-ontmantelen (in Dutch)
[54] with the exception of removal of construction works.
[55] Bulgarian Waste Management Act, http://www3.moew.government.bg/files/file/PNOOP/Acts_in_English/Waste_Management_Act.pdf
[56] The Dutch Demolition Code: http://www.sloopcode.nl/site/media/Dutch_Demolition_Code_EN.pdf
[57] For an example: http://www.theconcreteinitiative.eu/newsroom/publications/165-closing-the-loop-what-type-of-concrete-re-use-is-the-most-sustainable-option
[58] An example is the Flemish OVAM website which informs about the legislation regarding recycled granulates (in Dutch only) http://www.ovam.be/gerecycleerdegranulaten

regional and/or national authorities all play a role. It is the construction/renovation/demolition company's responsibility to acquire the necessary knowledge with respect to the planned operations.

27. **Local government can actively contribute to cooperation along the waste value chain.** The construction value chain is complex and includes both professional and private builders and renovators. Costs and benefits of C&D waste management are not distributed equally along the value chain; costs tend to be incurred during the early stages whilst benefits tend to accrue further downstream. Examples of cooperation initiatives are 'recycling platforms' (or waste transfer facilities), or virtual platforms (e.g. websites) that bring companies into contact with each other.

28. Once the quality of C&D waste and the waste management process itself have been addressed, it is time to **address the public perception, awareness and acceptance of C&D recycled materials.** It is therefore important that all actors in the value chain are sufficiently aware of the value inherent in working with C&D recycled materials, as well as having confidence in them.

29. All policy and framework conditions need to provide the appropriate incentives in a **concerted and coherent manner**, consistently across all authorities – from municipalities, cities and regions to Member States and European Union. This requires various authorities to communicate with each other on a regular basis.

30. **Consultation with all key stakeholders** (including industry and NGOs) at the beginning of the process is important. There are a variety of ways to start and topics to consult on: 1) Measure current practices and collect data; 2) Support in the organisation of the sector along the value chain; 3) Communicate about norms, rules and laws set for C&D recycled materials; 4) Develop an information campaign on the quality of C&D recycled materials; 5) Raise awareness about the pitfalls of NIMBY effects.

31. **The broader public can also be engaged** by stimulating the identification of and reporting on illegal dumping. For example, apps can be used for citizens to take pictures of illegal dumping activities and send them the authorities in charge of enforcement.

Annex A Definitions

Accreditation: denotes both a status and process[59]. As a status it denotes conformity to a specific standard as set forth by an accrediting agency and as a process it shows a commitment to continuous improvement. Accreditation means that the certification body meets the requirements of a national or an international standard as assessed by an accrediting agency.

Backfilling: any recovery operation where suitable waste is used for reclamation purposes in excavated areas or for engineering purposes in landscaping or construction instead of other non-waste materials which would otherwise have been used for that purpose.[60]

CE Marking for construction products: indicates that manufacturers take responsibility for the conformity of their products with the declared performance[61].

Certification: is a procedure by which a third party gives written assurance that a product, process or service is in conformity with certain standards[62]. Certification can be seen as a form of communication along the supply chain. The certificate demonstrates to the buyer that the supplier complies with certain standards, which might be more convincing than if the supplier itself provided the assurance.

Construction and Demolition waste: any waste generated in the activities of companies belonging to the construction sector and included [63] in category 17 of the European List of Wastes. The category 17 provides for codes for several individual materials that can be collected separately from a construction or demolition site. It includes waste streams [hazardous and non-hazardous; inert, organic and inorganic] resulting from construction, renovation and demolition activities. C&D waste originates at sites where construction, renovation or demolition takes place. Construction waste contains several materials, often related to cut-offs or packaging waste. Demolition waste comprises all materials found in constructions. Renovation waste can contain both construction-related materials and demolition-related materials. A detailed description of waste streams can be found in Annex B.

Collection of waste: means the gathering of waste, including the preliminary sorting and preliminary storage of waste for the purposes of transport to a waste treatment facility.

Co-processing: is the term used when introducing alternative fuels and raw materials into a standard production process, rather than using conventional fuels and raw materials.

Decontamination: reduction or removal of chemical agents.

Waste management plan: sets out the approach to demolition, the treatment and logistics of the materials identified in the pre-demolition audit.

Final recycling process: means the recycling process which begins when no further mechanical sorting operation is needed and waste materials enter a production process and are effectively reprocessed into products, materials or substances.[64]

Fixation materials: include non-structural materials (all materials apart from aggregates).

[59] ANSI accreditation, https://www.ansi.org/accreditation/faqs.aspx#2
[60] COM(2015) 595 final, Proposal for a Directive of the European Parliament and of the Council amending Directive 2008/98/EC on waste, Article 3(f), http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32008L0098
[61] Regulation (EU) No 305/2011 CPR, http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32011R0305
[62] ISO, 1996, http://certifications.thomasnet.com/certifications/glossary/quality-certifications/iso/iso-14001-1996/
[63] In addition, other categories may apply as well in case of deconstruction, f.i. cat 16 (TL lamps, …)
[64] COM(2015) 595 final, Proposal for a Directive of the European Parliament and of the Council amending Directive 2008/98/EC on waste, Article 2(f), http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32008L0098

Hazardous C&D waste: is defined as debris that has hazardous properties and that may prove to be harmful to human health or the environment. This comprises contaminated soil and dredging spoil, materials and substances that may include adhesives, sealants and mastic (flammable, toxic or irritant), tar (toxic, carcinogenic), asbestos-based materials in the form of respirable fibre (toxic, carcinogenic), wood treated with fungicides, pesticides, etc. (toxic, ecotoxic, flammable), coatings of halogenated flame retardants (ecotoxic, toxic, carcinogenic), equipment with PCBs (ecotoxic, carcinogenic), mercury lighting (toxic, ecotoxic), systems with CFCs, insulation containing CFCs[65], containers for hazardous substances (solvents, paints, adhesives, etc.) and the packaging of likely contaminated waste.

Inert waste: means waste that does not undergo any significant physical, chemical or biological transformations (for ex. concrete, bricks, masonry, tiles). Inert waste will not dissolve, burn or otherwise react physically or chemically, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health.[66]

Integrated waste management plans and strategies: a geographically-based plan that promotes and supports the C&D waste management.

Labelling: a certification label is a label or symbol indicating that compliance with standards has been verified[67]. Use of the label is usually controlled by the standard-setting body. Where certification bodies certify against their own specific standards, the label can be owned by the certification body.

Landfill: means a waste disposal site for the deposit of the waste onto or into land (for instance underground), including:

- internal waste disposal sites (for instance own waste disposal carried out by the producer of waste at the place of production), and
- a permanent site (older than one year) which is used for temporary storage of waste,

But excluding:

- facilities where waste is unloaded in order to permit its preparation for further transport for recovery, treatment or disposal elsewhere, and
- storage of waste prior to recovery or treatment for a period less than 3 years as a general rule,
- storage of waste prior to disposal for a period less than 1 year.[68]

Mixed C&D waste: mixture of different fractions of C&D waste.

Pre-demolition audit: a preparatory activity with the purpose of (1) collecting information about the qualities and quantities of the C&D waste materials that will be released during the demolition or renovation works and (2) giving general and site-specific recommendations regarding the demolition process.

Preparing for re-use: means checking, cleaning or repairing waste materials for recovery operations. The waste, products or components of products, that have been collected by a recognised re-use operator or deposit-refund scheme, are prepared so that they can be re-used without any further pre-processing.[69]

Re-use: means any operation by which products or components that are not waste are used again for the same purpose for which they were conceived.[70]

[65] Code 170603
[66] Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste, Article 2(e), http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A31999L0031
[67] Ibid.
[68] Ibid.
[69] COM(2015) 595 final, Proposal for a Directive of the European Parliament and of the Council amending Directive 2008/98/EC on waste, Article 2(e), http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32008L0098
[70] Directive 2008/98/EC on waste (Waste Framework Directive), Article 3(13), http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0098

Recycling: means any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes[71]. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations.

Recovery: means any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy.[72]

Renovation: can be defined as work that involves the structural alteration of buildings, the substantial replacement of main services or finishes and/or the substantial changed use of floor space whilst at the same time including associated redecoration and repair works on the one hand and related new building on the other. Renovation covers all the work done to existing buildings as the four R's: renovation, rehabilitation, restoration and remodelling. Renovation is addressed from a broad perspective, including residential, historical and commercial buildings owned and managed by private/public companies or authorities.

Refuse-Derived Fuels: waste that is used entirely or to a large extent for the purpose of energy generation. Waste materials which are generally reusable as RDF include tyres, rubber, paper, textiles, exhausted oils, wood, plastics, industrial waste, hazardous waste and solid urban waste.

Scavenging: is the activity of identifying usable materials that takes place after demolition; in this context, particularly re-usable and recyclable materials.

Selective demolition: involves sequencing the demolition activities to allow the separation and sorting of building materials.

Separated collection: collection where a waste stream is kept separately by type and nature so as to facilitate a specific treatment.[73]

Stockpiling location: is a platform for storing waste that can be moved.

Stripping: is the activity of removing valuable materials from a site, installation or building that takes place before demolition.

Waste holder: the waste producer or the natural or legal person who is in possession of the waste.

Waste producer: any natural or legal person whose activities produce waste (original waste producer) or anyone who carries out pre-processing, mixing or other operations resulting in a change in the nature or composition of this waste.

Waste management: the collection, transport, recovery and disposal of waste, including the supervision of such operations and the after-care of disposal sites, and including actions taken as a dealer or broker.[74]

Waste transfer station: is any site, location, tract of land, installation, or building that is used or intended to be used primarily for the purpose of transferring solid wastes.[75]

Waste treatment: means recovery or disposal operations, including preparation prior to recovery or disposal.

[71] Directive 2008/98/EC on waste (Waste Framework Directive), Article 3(17), http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0098
[72] Directive 2008/98/EC on waste (Waste Framework Directive), http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0098
[73] Ibid.
[74] Ibid.
[75] Recyclingportal.eu, Report: Waste transfer stations in different EU regions, 2009, http://www.recyclingportal.eu/artikel/22506.shtml

Annex B C&D Waste classification

This list is taken from the Commission Decision on the European List of Waste (Commission Decision 2000/532/EC[76]). Excavated soils (17 05) are included in the list but excluded from the Protocol.

Overview of C&D waste

17 01 CONCRETE, BRICKS, TILES AND CERAMICS

- 17 01 01 concrete
- 17 01 02 bricks
- 17 01 03 tiles and ceramics
- 17 01 06 mixtures of, or separate fractions of concrete, bricks, tiles and ceramics containing dangerous substances
- 17 01 07 mixtures of concrete, bricks, tiles and ceramics other than those mentioned in 17 01 06

17 02 WOOD, GLASS AND PLASTIC

- 17 02 01 wood
- 17 02 02 glass
- 17 02 03 plastic
- 17 02 04 glass, plastic and wood containing or contaminated with dangerous substances

17 03 BITUMINOUS MIXTURES, COAL TAR AND TARRED PRODUCTS

- 17 03 01 bituminous mixtures containing coal tar
- 17 03 02 bituminous mixtures other than those mentioned in 17 03 01
- 17 03 03 coal tar and tarred products

17 04 METALS (INCLUDING THEIR ALLOYS)

- 17 04 01 copper, bronze, brass
- 17 04 02 aluminium
- 17 04 03 lead
- 17 04 04 zinc
- 17 04 05 iron and steel
- 17 04 06 tin
- 17 04 07 mixed metals
- 17 04 09 metal waste contaminated with dangerous substances
- 17 04 10 cables containing oil, coal tar and other dangerous substances
- 17 04 11 cables other than those mentioned in 17 04 10

17 06 INSULATION MATERIALS AND ASBESTOS-CONTAINING CONSTRUCTION MATERIALS

- 17 06 01 insulation materials containing asbestos
- 17 06 03 other insulation materials consisting of or containing dangerous substances
- 17 06 04 insulation materials other than those mentioned in 17 06 01 and 17 06 02
- 17 06 05 construction materials containing asbestos

17 08 GYPSUM-BASED CONSTRUCTION MATERIAL

- 17 08 01 gypsum-based construction materials contaminated with dangerous substances
- 17 08 02 gypsum-based construction materials other than those mentioned in 17 08 01

17 09 OTHER CONSTRUCTION AND DEMOLITION WASTES

- 17 09 01 construction and demolition wastes containing mercury
- 17 09 02 construction and demolition wastes containing PCB (for example PCB containing sealants, PCB-containing resin-based floorings, PCB-containing sealed glazing units, PCB-containing capacitors)
- 17 09 03 other construction and demolition wastes (including mixed wastes) containing dangerous substances
- 17 09 04 mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03

[76] Commission Decision 2000/532/EC, http://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:32000D0532

Annex C Hazardous properties

Annex III to the Waste Framework Directive[77] describes 15 properties (HP1 to HP15) of waste which renders it hazardous. The table below provides an overview of the hazardous properties.

Hazardous Properties	
HP1	Explosive
HP2	Oxidising
HP3	Flammable
HP4	Irritant – skin irritation and eye damage
HP5	Specific Target Organ Toxicity (STOT)/Aspiration Toxicity
HP6	Acute Toxicity
HP7	Carcinogenic
HP8	Corrosive
HP9	Infectious
HP10	Toxic for reproduction
HP11	Mutagenic
HP12	Release of an acute toxic gas
HP13	Sensitising
HP14	Ecotoxic
HP15	Waste that can exhibit a hazardous property listed above, not directly displayed by the original waste

Hazardous C&D waste comprises contaminated soil and dredging spoil, materials and substances that may include flammable additives, adhesives, sealants and mastic (flammable, toxic or irritant), tar emulsions (toxic, carcinogenic), asbestos-based materials in the form of breathable fibre (toxic, carcinogenic), wood treated with fungicides, pesticides, etc. (toxic, ecotoxic, flammable), coatings of halogenated flame retardants (ecotoxic, toxic, carcinogenic), equipment with PCBs (ecotoxic, carcinogenic), mercury lighting (toxic, ecotoxic), systems with CFCs, elements (which may be a possible source of sulphide in landfills, toxic, flammable), containers for hazardous substances (solvents, paints, adhesives, etc.) and the packaging of likely contaminated waste.[78] These materials are usually found in demolition works, due mainly to the absence of past legislation regarding the use of certain hazardous materials such as asbestos and lead. Material re-use should not be neglected however, as these materials are not classified as waste and therefore not regulated, but in some cases these projects can also generate similar dangerous waste.

[77] Directive 2008/98/EC on waste (Waste Framework Directive), http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0098

[78] Pacheco-Torgal, Tam, Labrincha, Ding and de Brito, Handbook of recycled concrete and demolition waste, 2013, Woodhead Publishing Limited (ISBN 978-0-85709-682-1)

Annex D Best practice examples

1. Best practice examples of waste identification, source separation and collection:

Box 1: The French example of identifying waste from demolition and refurbishment of buildings

The French regulation for construction and building projects specifies how to identify waste from demolition and refurbishment of buildings. The buildings concerned are those with a surface area of more than 1000 square meters for each floor or farm, industrial or commercial building that has been exposed to hazardous substances. The works concern the reconstruction and/or demolition of a major part of the structure of the building. The contracting entity has to carry out the identification before applying for the demolition permit or before accepting estimates for contracting.

The identification lists the nature, the amount and the location of material and waste and their means of management, notably those which are re-used on site, recovered or eliminated. This list is provided to anyone involved in the demolition works.

At the end of the works, the contracting authority writes an assessment of works indicating the nature and the amount of material actually re-used on site and that of waste that is recovered or eliminated. The contracting entity sends the form to the French Environment and Energy Management Agency which presents a yearly report to the Ministry in charge of construction.

Source: Cerema, 2016, https://www.legifrance.gouv.fr/eli/decret/2011/5/31/DEVL1032789D/jo
And https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000025145228

Box 2: Dutch certification scheme for demolition processes (BRL SVMS-007)

The BRL SVMS-007 is a voluntary (not legally binding) instrument to encourage a quality demolition process. Customers who prescribe to this certification scheme of procurement and tendering are assured of environmentally and safe demolition on site. The scheme is controlled by third parties and the Council of Accreditation. The certified demolition process follows four steps:

- **Step 1 Pre-demolition audit**: The demolition contractor carries out an advanced inspection of the demolition project and an inventory of the materials (hazardous and non-hazardous) to get insight into the nature, quantity and any contamination of the extracted demolition materials. An inventory is made of the risks to occupational safety and safety risks to the surroundings.
- **Step 2 Waste management plan**: A waste management plan is drawn up that includes a description of the method of selective demolition and environmentally-friendly demolition, processing and removal of released material flows, safety measures that have to be taken and implementation requirements of the customer.
- **Step 3 Execution**: The execution of the demolition occurs in accordance with the waste management plan. Experts in the area of safety and environmentally-friendly demolition are involved and certified demolition contractors work with approved equipment. The demolition contractor must ensure that the demolition location is safe and well organised and that the released material flows do not contaminate the soil and the surroundings.
- **Step 4 Final report**: The delivery of the project takes place in consultation with the involved parties. A final report of the released demolition materials is drawn up by the demolition contractor, and it is supplied to the customer upon request.

Source: BRL SVMS-007, 2016,www.veiligslopen.nl/en/home in English and Dutch

Box 3: List of C&D materials that need to be removed from the building before demolition – example of the Austrian standard ÖNORM B3151

C&D materials representing or containing dangerous substances:

- Loose artificial mineral fiber (if hazardous);
- Components or parts containing mineral oil (such as an oil tank);
- Smoke detectors with radioactive components;
- Industrial smoke stacks (for ex., fireclay boxes, bricks or lining);
- Insulating material made up of components containing Chlorofluorocarbon ((H)CFC) (like sandwich elements);
- Slags (for ex., slags in inserted ceilings);

- Oil-contaminated or otherwise contaminated soils;
- Fire debris or otherwise contaminated debris;
- Isolations containing polychlorinated biphenyl (PCB);
- Electrical properties or equipment with pollutants (for ex., vapor discharge lamps containing mercury, fluorescent tubes, energy-efficient lamps, capacitors containing PCB, other electrical equipment containing PCB, cables containing insulation liquids);
- Cooling liquid and insulations from cooling devices or air-conditioning units containing Chlorofluorocarbon ((H)CFC);
- Materials containing polycyclic aromatic hydrocarbon (PAH) (like tar bitumen, tar board, cork block, slags)
- Components containing or impregnated with salt, oil, tar, phenol (e.g. impregnated wood, cardboard, railway sleepers, masts);
- Material containing asbestos (for ex., asbestos cement, sprayed asbestos, night storage heaters, asbestos flooring);
- Other hazardous materials.

Source: https://shop.austrian-standards.at/action/de/public/details/532055/OENORM_B_3151_2014_12_01;jsessionid=A137F6D21D0C77F9937C7A46D398232A in English and German

Box 4: Gypsum to gypsum project (GtoG)

The main objective of the GtoG project is to change the way gypsum-based waste is treated. Gypsum products can be counted amongst the very few construction materials where "closed-loop" recycling is possible: where the waste is used to make the same product again. Gypsum as such is 100% and eternally recyclable.

Despite the fact that a closed loop is possible, the reality is different. The GtoG project aims at transforming the European gypsum demolition waste market to achieve higher recycling rates of gypsum waste. Close loop recycling for gypsum products will only happen if:

- Dismantling practices are applied systematically (as standard) instead of demolishing buildings;
- Preferably, sorting of waste is done at source, avoiding mixed waste and contamination;
- Recycled gypsum will meet stringent specifications in order to be re-incorporated in the manufacturing process.

Source: Eurogypsum, 2016, http://gypsumtogypsum.org/ in English

Box 5: Factors affecting recovery of materials in the demolition process

The extent to which materials may be recovered effectively in the demolition process depends on a range of factors, including the following ones:

- Safety, which may increase project costs;
- Time. Selective demolition needs more time than traditional demolition, so higher costs are expected. Optimal solutions regarding potential recyclability and re-use should be considered.
- Economic feasibility and market acceptance. The cost of removing an element (e.g. a roof tile) should be compensated for by its price, while, at the same time, the re-used element should be competitive and accepted by future users. For some materials, e.g. iron/metal/scrap, market prices fluctuate strongly depending also on seasonality.
- Space. When there is a space limitation on a site, separation of materials collected should take place in a sorting facility. Space limits specifically require good planning.
- Location. The number of recycling facilities in the surroundings of the project site or the local supply waste management services may limit the potential recovery of materials from a deconstruction project.
- Weather. Some techniques may be dependent on certain require certain weather conditions that may not coincide with project timing.

Source: The Joint Research Centre/Directorate-General Environment, Best Environmental Management Practice of the Building and Construction Sector, 2015, p.28, http://susproc.jrc.ec.europa.eu/activities/emas

2. Best practice examples on waste logistics

Box 6: Mineral waste traceability in the French construction industry

In France, any waste producer or waste holder is responsible for waste management until its disposal or final recovery, even when waste is transported to a specialised facility in order to be treated. The French regulation requires that waste producers provide a document specifying the transportation of waste from their production site and the nature of the waste. This document must be provided before it can enter waste treatment facilities that accept non-hazardous inert waste. Producers of recycled aggregates choose to implement a waste traceability system at their treatment facilities. This traceability ensures the quality of treatment and enables users to be informed of possible uses of recycled aggregates from waste, taking into account environmental and geotechnical criteria.

Source: Cerema, 2016

Box 7: French Electronic Traceability System

Ivestigo is a traceability software for C&D waste. Launched by the French Demolition Association (SNED), this online platform aims to ease traceability work and respect the French wastes regulations for companies. More specifically, a user can create, edit and print waste tracking forms for all C&D waste (inert, non-hazardous, hazardous and asbestos), and keep a waste register for each demolition works according to French regulations. A dashboard and several indicators allow companies to follow thoroughly the wastes they produce and improve communication with clients. Finally, Ivestigo is free of charge for the French Demolition Association's members.

Source: Ivestigo, 2016, http://www.ivestigo.fr/ in French

Box 8: Tracimat – a Belgian example of a C&D waste tracking

Tracimat[79] is a non-profit, independent demolition management organization recognized by the Belgian public authorities that issue a "certificate of selective demolition" for a specific C&D material that has been collected selectively at the demolition site and subsequently gone through a tracing system. The demolition certificate shows the processor whether the C&D material can be accepted as "low environmental risk material" which means that the purchaser (recycling plant) can be quite sure that the C&D material meets the quality standards for processing at the recycling plant. Therefore the "low environmental risk material" can be processed separately from "the high environmental risk material". Because of the unknown origin and/or the unknown quality the "high environmental risk material" must be controlled more stringently than the "low environmental risk material" so the processing will be more expensive. All this will boost trust in the demolishing contractors and the recycled product, resulting in improved and more widespread marketing of recycled C&D materials. In the future, other demolition waste management organizations could be recognized by the relevant public authorities.

Tracimat does not issue a certificate of selective demolition until the waste has gone through the traceability system. The tracing process starts with the preparation of a demolition inventory and waste management plan prepared by an expert prior to the selective demolition and dismantling work. To guarantee the quality of the demolition inventory and waste management plan, they must be prepared according to a specific procedure. Tracimat will check the quality of the demolition inventory and waste management plan and issue a declaration on its conformity. Tracimat checks whether both the hazardous waste and the non-hazardous waste that complicates the recycling of the specific demolition C&D material, have been selectively and properly disposed of. Tracimat initially focused on the stony fraction, which in terms of weight by far represents the greatest portion of the construction and demolition waste and will deal with other C&D materials at a later stage.

The 'eenheidsreglement' is a certification regulation for recycled aggregates that consist of an internal control and an external control by an accreditated certification organisation. 'Clean input gives clean output' is the general motto of this policy. It also explains the distinction between streams with a Low Environmental Risk Profile (LERP) and streams with a High Environmental Risk Profile (HERP). In fact the Tracimat-system is one way for the crusher to accept debris as LERP, beside other possibilities. So the 'eenheidsreglement' stands on its own and is a management system and certification regulation for recycled aggregates. Tracimat is a type of tracing system for debris derived from selective demolition.

[79] This project has received funding from the European Union's Horizon 2020 research and innovation programme, https://ec.europa.eu/programmes/horizon2020/ , under grant agreement No 642085

Source: Flemish Construction Confederation, 2016, http://hiserproject.eu/index.php/news/80-news/116-tracimat-tracing-construction-and-demolition-waste-materials in English

3. Best practice examples of waste processing and treatment

Box 9: Re-use of construction materials in a temporary construction site – example of the London 2012 Olympic Park

The Olympic Delivery Authority (ODA) set demanding sustainability targets for the Olympic Park demolition, including an overall target of at least 90% by weight of demolition material to be re-used or recycled. The ODA's overall target was exceeded by 8.5%, with less than 7,000 tonnes landfilled. The key lessons learned from this project include:

1) Undertake a pre-demolition audit and include a reclamation survey.
2) Use this data, and consultations with reclamation specialists, to set headline targets for re-use and reclamation for key materials before issuing tenders, ideally linked to carbon targets.
3) Include clear reclamation and re-use targets as separate and additional to the overall recycling target and state them clearly in the tendering process and in contracts. Make explicit the responsibility for demolition.
4) Incentivise use of specialist contractors and achieving of re-use targets.
5) Require the project to measure the total carbon impact of the demolition process and the new construction on the site.
6) Require re-use to be entered into a materials database and included in Site Waste Management Plans.
7) Design team workshops and communication with other local regeneration projects are recommended; regular site visits are vital.
8) Include use of site-won re-used materials in the design and construction contracts for the new build.
9) Sufficient storage space is vital to enable re-use of construction products.

Source: BioRegional, 2011, http://www.bioregional.com/wp-content/uploads/2015/05/Reuse-and-recycling-on-London-2012-olympic-park-Oct-2011.pdf in English

Box 10: OPALIS - online inventory of the professional sector in salvaged building materials around Brussels

The OPALIS project is website that builds a bridge between second-hand dealers and commissioning agents such architects, and building contractors by providing an online inventory of the professional sector in salvaged building materials, and in so doing increasing the potential, both in terms of collecting salvaged materials and in offering these materials for sale.

The site contains detailed information and photos from all dealers within a one-hour drive radius around Brussels (but also provides some names of companies in France and the Netherlands), as well as information about different types of materials. Given the local nature of the project, the website is bilingual in French and Dutch.

Source: Opalis, 2016, http://opalis.be/

Box 11: Recycling of PVC

PVC (polyvinyl chloride) compounds are well easily recyclable physically, chemically or energetically. After mechanical separation, grinding, washing and treatment to eliminate impurities, it is reprocessed using various techniques (granules or powder) and re-used in production. Main elements made of PVC in buildings include piping/fitting and window frames. Throughout Europe there are Member States and regions where PVC window frames are separated at source and collected separately. In some instances window frames can be given away at collection sites at no cost. PVC is recycled into new window frames and the technology for recycling PVC tubes into new tubes has also been developed. Indeed, this has been done at industrial scale since the beginning of the century.

Source: Fédération Internationale du Recyclage (FIR), 2016 and www.vinylplus.eu in English and French

Box 12: Wood recycling into wood-based panels

Wood can be recycled into particle boards. In 2014, the European particle board industry in the EPF member countries consumed 18.5 million tonnes of wood raw material. The average share of recovered wood was 32%, the other raw material categories being processed round wood (29%) and industrial by-products (39%). Recovered wood continued

to be used as the major raw material source in Belgium, Denmark, Italy and the United Kingdom. Austria, Germany, Spain and France also used important quantities of recovered wood for particle board manufacturing, reflecting the encompassing problem of wood availability. Other European countries still use primarily roundwood and industrial residues due to the lack of an efficient collecting system or thanks to less pressure from the incentivised bioenergy sector. The share of CDW in the recovered wood fraction used for panel production is currently rather low but rising with the improvement of appropriate source separation and collection from C&D sites.

Source: European Panel Federation (EPF) and Europanels, www.europanels.org, 2016 in English

Box 13: Recycling and re-use of mineral wool

Mineral wool can be recycled into new mineral wool products and it can serve as raw material for bricks and ceiling tiles, for example. Mineral wool construction waste arises in very small quantities at construction or renovation sites. As mineral wool is flexible by nature, often rest material will be re-used on-site immediately to fill gaps for example, resulting in low quantities of remaining waste. Recycling of this clean waste stream is technically possible, but is a costly and infrastructure-driven process as for all stakeholders. Requirements for selective demolition and separation of waste streams are a pre-requisite, whereas after-sorting will often be necessary to guarantee sufficiently clean waste stream.

Today's release of mineral wool demolition waste is rather small but the quantities will increase in the future, as the buildings from the 1970's or 80's get old and the average renovation time is 30+ years. Collection and recycling of mineral wool demolition waste thus very much relies on demolition and sorting techniques as well as economic viability and regulatory frameworks. Mandatory separation, after-sorting obligations and training could improve this situation, although the small quantities (as well in weight) of mineral wool demolition waste remain a barrier for cost-effective solutions.

Information Sheet on Waste Handling of Mineral Wool Insulation:
http://www.eurima.org/uploads/ModuleXtender/Publications/151/Eurima_waste_handling_Info_Sheet_06_06_2016_final.pdf

Mineral Wool - Deconstruction in Practice video:
https://www.youtube.com/watch?v=H4amG-f69mA

Source: European Insulation Manufacturers Association (EURIMA), 2016, http://www.eurima.org/ in English

Box 14: The Netherlands' history of recycling C&D waste

Recycling of C&D waste in the Netherlands started in the 1980's. The main driver was the contaminated soil issue arising from landfills. In response, the Netherlands developed its Waste Hierarchy. The implementation of the new policy consisted of landfill bans and recycling targets. A national plan was developed for C&D waste by all stakeholders, assigning tasks and responsibilities to each stakeholder. A specific task for the recycling industry was the development of quality assurance schemes.

Recycling started off by relatively simple crushing of inert C&D waste into recycled aggregates. These were used for various applications, including what now is seen as "backfilling". Crushing of inert C&D waste has been the prime activity for many years. As also the landfilling of mixed C&D waste was prohibited, new plants for sorting of this material were started up. These plants recover materials such as wood, metals, plastics and inerts. The residual fraction is partially used to produce a secondary fuel.

The quality of recycled aggregates improved over the years. Processes improved and so did quality control. For many years now, recycled aggregates are prescribed by the Ministry of Transport purely on the basis of its outstanding technical characteristics. The environmental quality is fully assured through certification schemes that include the requirements of the Soil Quality Decree. Increasingly, recycled aggregates are also used in the production of concrete. Recycling of asphalt has gone through a similar process. Nowadays, almost all asphalt is recycled into new asphalt. Wood recycling is also frequent, although a main alternative outlet for wood is still biomass for power generation (energy recovery).

Recycling of several other materials has proven to be more difficult. These materials constitute smaller fractions of C&D waste and recycling of these fractions usually requires more input. Other materials, which are being recycled progressively are:

- Flat glass*:* A collection scheme exists for flat glass initiated by the glass industry and the glass can be delivered to collection points for free. PVC windows: A collection scheme exists for PVC windows, and also these can be delivered for free to collection points.
- Gypsum*:* A few years ago an agreement was made between government and industry to make the Netherlands a leader of the recycling of gypsum. Gypsum is kept separate mainly in order to not affect the quality of recycling of inert C&D waste.
- PVC pipes*:* One recycler has developed a recycling process for PVC pipes. PVC is micronized in order to meet the requirements for use in new PVC pipes.
- Roofing material. Bitumen roofing material can be recovered and processed, and used partly in new roofing constructions and partly in asphalt.

Source: European Panel Federation (EPF), 2016, http://www.fir-recycling.com/ in English

Box 15: Swedish guidelines for resource and waste handling in construction and demolition

The guidelines for resource and waste handling in construction and demolition were originally published in 2007 by the Swedish Construction Federation. The latest updated version of the guidelines from year 2016 contains normative industry texts for the following processes:

- Pre-demolition audit, together with procurement;
- Lists of examples and guides for specific materials, commonly encountered at demolition, which should be specified in pre-demolition audit documentation;
- Re-use, waste sorting at source and waste management, together with procurement of contractors for demolition;
- Waste sorting at source and waste management, together with procurement of contractors for construction.

Source: Sveriges Byggindustrier, 2016, *https://publikationer.sverigesbyggindustrier.se/Userfiles/Info/1094/160313_Guidelines_.pdf* in English and Swedish

Box 16: Circular Economy package on backfilling[80]

By 2020, the preparation for re-use, recycling and backfilling of non-hazardous construction and demolition waste in the list of waste will be increased to a minimum of 70% by weight in all Member States. An exclusion is made for naturally occurring material defined in category 17 05 04.

For the purpose of verifying compliance with Article 11(2)(b)[81], the amount of waste used for backfilling operations shall be reported separately from the amount of waste prepared for re-use or recycled. The reprocessing of waste into materials that are to be used for backfilling operations shall be reported as backfilling.

Source: European Commission, 2016, http://ec.europa.eu/environment/circular-economy/index_en.htm

Box 17: Bulgarian Ordinance on C&D waste used for backfilling

According to the Bulgarian Ordinance on construction and demolition waste management and use of recycled building materials construction and demolition waste can be used for backfilling only if:

- The construction and demolition waste used complies with the requirements of the project;
- The person responsible for the material recovery holds a permit for recovery; operation code R10.

According to the same Ordinance, backfilling can be material recovery only if the C&D waste is inert and is treated.

Source: Ministry of Environment and Water of Bulgaria, 2016

4. Best practice examples of quality management and assurance

Box 18: EMAS - Best Environmental Management Practice in the Waste Management Sector

The EU Eco-Management and Audit Scheme, EMAS, is a voluntary environmental management scheme for all types of private and public organisations to evaluate, report on and improve their environmental performance.

[80] Circular Economy package, COM(2015) 595 final
[81] Circular Economy package, COM(2015) 595 final

In accordance with Article 46 of EMAS, the European Commission's Joint Research Centre (JRC), in consultation with EU Member States and other stakeholders, identifies, evaluates and documents Best Environmental Management Practices (BEMPs) for different sectors, including the construction sector[82]. The JRC is preparing two documents describing the BEMPs for each sector: a concise Sectorial Reference Document (SRD), and a detailed technical report. Sectorial reference document provides information on best environmental management practice, use of environmental performance or core indicators for specific sectors, benchmarks of excellence and ratings systems identifying environmental performance levels.

The JRC is currently developing the document "Best Environmental Management Practice in the Waste Management Sector", which will cover three waste streams: C&D waste, municipal solid waste and medical waste. The document will cover the following waste activities: waste management, prevention, re-use, collection and treatment.

Source: The Joint Research Center, 2016, http://susproc.jrc.ec.europa.eu/activities/emas/index.html in English

Box 19: QUALIRECYCLE BTP, a French audit tool designed for C&D waste management companies

The voluntary French Management and Audit Scheme, QUALIRECYCLE BTP, is a management scheme developed by Syndicat des Recycleurs du BTP (SR BTP) for waste management companies to evaluate, report and improve their performance in the compliance, environment and safety fields and show their commitment to recovering issues.

The framework of the scheme contains 5 sections with mandatory and recommended parameters to assess the level of:

- Governance and transparency
- Regulatory compliance
- Monitoring of the environmental effects of the activity
- Safety of people and work conditions
- Performance in terms of sorting and recovering rates.

The label is delivered by the follow-up committee of the Syndicat des Recycleurs du BTP (professional organization linked to the French construction association), after a labelling audit carried out by an independent consultant.

Source: SR BTP, www.recycleurs-du-btp.fr/quali-recycle-btp/ in French

Box 20: Standards for recycled wood

Since more than 15 years, manufacturers apply industry standards for the use of recycled wood for the production of wood-based panels. A first EPF standard aims at ensuring that wood-based panels are as safe as toys and are environmentally friendly. It is based on European standards on safety of toys that lay down limit values for the presence of potential contaminants. The second EPF industry standard describes the conditions under which recycled wood can be accepted for the manufacturing of wood-based panels. This standard comprises general requirements on quality and chemical contamination, classes of unacceptable materials (e.g. wood treated with PCP) as well as reference methods for sampling and testing.

Source: European Panel Federation (EPF), 2016, www.europanels.org in English

5. Best practice examples of policy and framework conditions

Box 21: Integrated Waste Management Strategies

An increasing number of local, regional and national governments prepare Integrated Waste Management Strategies. Such a strategy:

- Involves stakeholders from the local construction industry, main developers, associations, NGOs and relevant public administration departments, including regional organisations.
- Prioritises waste prevention through several mechanisms oriented at the construction industry.
- Establishes minimum waste sorting and management requirements in construction sites of a certain size.
- Identifies and quantifies future flows of wastes and establishes monitoring mechanisms.

[82] The Joint Research Centre, http://susproc.jrc.ec.europa.eu/activities/emas/construction.html

- Calculates total costs and the impact of its implementation.
- Establishes objectives for recycling in 2020 with appropriate monitoring mechanisms and, in some cases, enforcement mechanisms.
- Aims to provide clear guidance, especially for SME and very small producers.
- Identifies and quantifies collection and treatment needs.
- Identifies recycling opportunities and provides realistic frameworks for industry for its implementation.

Source: The background document for the EMAS Sectorial Reference Documents (SRDs) on Best Environmental Management Practices (BEMPs) for the waste management sector (p. 273), http://susproc.jrc.ec.europa.eu/activities/emas/waste_mgmt.html in English

Box 22: *The Asbestos Abatement Programme in Poland (2009-2032)*

The aims of The Programme for Asbestos Abatement in Poland 2009-2032 are:
1) Removal and disposal of products containing asbestos;
2) Minimising adverse health effects caused by the presence of asbestos in Poland;
3) Eliminating negative effect of asbestos on the environment.

The programme groups activities scheduled for the implementation at a central, voivodeship and local level in five subject areas:

a. Legislative activities;
b. Education and information activities addressed to children and youth, trainings for employees of government and self-government administrations, development of training materials, promotion of technologies for the destruction of asbestos fibres, organisation of national and international trainings, seminars, conferences, congresses and participation therein;
c. Activities related to the removal of asbestos and products containing asbestos from the constructions, public amenities and sites of former asbestos products producers, cleaning the premises, building landfills;
d. Monitoring of the programme implementation by means of electronic spatial information system;
e. Activities in the area of exposure assessment and health protection.

The Programme for Asbestos Abatement in Poland is published in English on website:
http://www.mr.gov.pl/media/15225/PROGRAM_ENG.pdf

Source: Polish Ministry of the Environment, 2016

Box 23: Decentralised taxes on sand, gravel and rock – the case of Italy

In Italy the application of taxes on sand, gravel and rock are decentralised and have been applied since the early 1990s. There is no common national rate of tax being applied. Instead every region applies different rates at provincial and municipal levels, per cubic meter of sand, gravel and rock extracted. The revenue from the taxes are accrued by the municipalities and legislation prescribes they are earmarked for 'compensatory investments' in localities of quarrying activity. In Italy, the charge on aggregates is only one element of a very complex planning, authorisation, and regulation system related to quarrying activities.

Extraction charges are not primarily aimed at reducing the quantity extracted or at promoting recycling. Instead their purpose is to contribute to the external costs associated with quarrying activities through financing land conservation investments implemented by municipalities and other institutions that share the revenues, which mostly accrue to municipalities. Results from the analysis suggest that the effect of the extraction charge has been very limited. The level of tax is generally too low (around EUR 0.41–0.57/m3) to have had any real effect on demand.

Source: EEA, Effectiveness of environmental taxes and charges for managing sand, gravel and rock extraction in selected EU countries, No 2/2008, http://www.google.nl/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwiFyYvjxaXPAhWCCBoKHTlkDakQFggeMAA&url=http%3A%2F%2Fwww.eea.europa.eu%2Fpublications%2Feea_report_2008_2%2Fdownload&usg=AFQjCNHK7j1OjkzVs0d3bLqSg0unmco-jw in English

Box 24: Recycled materials: REACH

Whereas registration based on REACH obligations do not apply to waste, such registration may become obligatory when waste ceases to be waste. The REACH regulation therefore only becomes of interest when such materials as recycled aggregates are no longer considered to constitute waste. In the specific case of recycled aggregates it is

important to note that, even when they cease to be waste, REACH registration obligations do not apply. The reason for that is that recycled aggregates are regarded as an article, in the sense of REACH[83]. Articles are exempted from the obligation to register. Due to article 7(2) and 33 of the REACH regulation, substances of very high concern (SVHC) in articles must be notified if they are present in a concentration higher than 0.1% w/w. Such substances are typically not identified in recycled aggregates.

Source: ECHA guidance on waste and recovered substances, 2010, http://echa.europa.eu/documents/10162/13632/waste_recovered_en.pdf in English

Box 25: The French environmental assessment approach to waste in road engineering

Since the beginning of the year 2000, the French Ministry for Sustainable Development has been studying the possibility of a single and harmonized approach to improve the use of alternative materials made from non-hazardous waste for road engineering. The process, carried out in collaboration with the economic stakeholders of the sector, has led to the development of a method, published in March 2011 by the SETRA (now Cerema). This method provides an approach to the environmental assessment of alternative materials in road engineering which takes into account:

- The improvements of European standards for leaching tests;
- The feedback from evaluation and feasibility studies regarding the use of certain types of recycled waste in road engineering;
- The approach selected in the framework of the European decision 2003/33/CE which has allowed the creation of a European harmonized process and storage.

This approach has been applied to 3 sources of waste: demolition waste, bottom ash from incinerators of non-hazardous waste and steel slag waste. It is currently applied to dredged sediments, foundry sands and ashes from thermal power plants.

Source: Cerema, 2016, http://www.centre-est.cerema.fr/guides-nationaux-r361.html in French

Box 26: Private and/or national systems for sustainable construction

The **LEED** (Leadership in Energy and Environmental Design) Rating Systems is a voluntary programme meant to measure objectively how sustainable a building is in several key areas: a) environmental impact on site and location; b) water efficiency; c) energy efficiency; d) material selection; e) indoor environmental quality. The system also encourages innovation.
Source: http://www.usgbc.org/leed in English

BREEAM (Building Research Establishment Environmental Assessment Method) is a sustainability assessment method for master-planning projects, infrastructure and buildings. It addresses a number of lifecycle stages such as new construction, refurbishment and in-use.
Source: http://www.breeam.com/in English

HQE™ (Haute Qualité Environnementale / High Environmental Quality) is a French certification awarded – also internationally - to building construction and management, as well as urban planning projects. HQE™ promotes best practices, sustainable quality in building projects and offers expert guidance throughout the lifetime of the project.
Source: http://www.behqe.com/ in English and French

[83] ECHA guidance on waste and recovered substances (2010), Appendix 1, chapter 1.4, http://echa.europa.eu/documents/10162/13632/waste_recovered_en.pdf

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- DG RTD - Research and Innovation;
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Annex F Checklist

Checklist
Construction & Demolition Waste Protocol

The Construction & Demolition Waste Protocol fits within the European Construction 2020 strategy[84], as well as the Communication on Resource Efficiency in the Building Sector[85] and Circular Economy Package[86]. The Protocol aims to increase confidence in the C&D waste management process and the trust in the quality of C&D recycled materials. This checklist helps practitioners of the construction and demolition industry to see if they have followed the most important steps in their demolition, construction and renovation projects to guarantee optimal reuse and recycling of construction materials.

Waste identification, source separation and collection

IMPROVE WASTE IDENTIFICATION

☐ Prepare a **pre-demolition audit**, carried out by a **qualified expert:**
- to specify the quantity, the quality and location of materials
- to identify what materials can be reused or recycled or need to be disposed of
- to take full account of local facilities and markets for C&D waste and reused and recycled materials.

☐ Prepare a process-oriented **waste management plan** showing how materials are to be reused or recycled.

☐ Decide on the best treatment options for different materials: cleaning for reuse, reuse, recycling in the same application or another application, incineration or disposal.

☐ Guarantee efficient **supervision** by local authorities or by an independent third party.

IMPROVE SOURCE SEPARATION

☐ **Keep materials separated** during the demolition and construction process to guarantee the quality of recycled aggregates and materials.

☐ **Remove hazardous waste** (decontamination) correctly and systematically prior to demolition.

☐ **Selectively demolish and dismantle** the main inert waste streams, often manually, and treat them separately.

☐ **Minimise packaging materials** as much as possible.

☐ **Provide necessary documentation** to all contractors to support transparency and monitoring.

[84] COM(2012) 433 final, http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2012:0433:FIN
[85] COM(2014) 445 final , http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2014:0445:FIN
[86] Circular Economy Package, http://ec.europa.eu/environment/circular-economy/index_en.htm

Waste logistics

TRANSPARENCY, TRACKING AND TRACING

- ☐ **Provide necessary documentation** to all contractors to support transparency and monitoring.
- ☐ **Use the European List of Waste** to assure comparability of data across the EU.

IMPROVE LOGISTICS

- ☐ Try to **keep distances short** to keep recycling economically attractive and environmentally sound.
- ☐ Optimise the transport network and make use of supporting IT systems.
- ☐ Where possible, use waste transfer stations and/or waste sorting and recycling services.
- ☐ **Guarantee the integrity** of materials from dismantling to recycling during transportation.

STOCKPILING POTENTIAL AND PROPER STOCKING

- ☐ **Proper stocking and stockpiling** of C&D materials is required in certain situations.
- ☐ Take **precautionary measures** to minimise emissions and risks, taking local conditions into account.

Waste processing and treatment

WASTE PROCESSING AND TREATMENT OPTIONS

- ☐ **Follow the waste hierarchy** to maximise benefits in terms of resource efficiency, sustainability and cost savings.
- ☐ Sort non-inert materials and products depending on their **economic value**, if possible.
- ☐ Process or treat materials on the basis of **environmental criteria and regulations** that are in place.

PREPARATION FOR REUSE

- ☐ **Reuse** as much material as possible, since reuse has an even greater environmental advantage than recycling.

RECYCLING

- ☐ Recycle materials, either **on-site** into new construction or **off-site** at a recycling plant.
- ☐ **Promote recycling**, particularly in densely populated areas where supply and demand are close together.
- ☐ Ensure **sound planning of waste management activities** to guarantee high recycling rates and high-quality recycling products.

MATERIAL AND ENERGY RECOVERY

- ☐ **Backfilling** can be considered in particular situations, when reuse or recycling into higher quality application is not possible.
- ☐ **Energy recovery** should be considered for materials that cannot be reused or recycled.

Quality management and assurance

QUALITY OF THE PRIMARY PROCESS

- ☐ Introduce quality management and quality assurance checks and tools **in all stages of the recycling route**.
- ☐ Make use of existing general **quality management schemes** like ISO 9000, ISO 14001 and EMAS.
- ☐ **Key quality management and assurance** checks and tools **per process step:**
  - **Waste identification, source separation & collection**: prepare a pre-demolition audit, on-site reporting and a final report for the recycling plant.
  - **Construction:** identify expected waste and amounts for preparation of a waste management plan.
  - **Waste logistics**: verify if the waste is hazardous or not and provide appropriate stocking and transport.
  - **Waste processing and treatment**: selective demolition-waste acceptance, factory production control, final testing.

QUALITY ASSURANCE RELATED TO PRODUCTS AND PRODUCT STANDARDS

- ☐ Follow the same European standards that apply to primary materials for recycled materials. Make use of existing European product standards (CPR).
- ☐ If these European product standards do not apply, make use of European Technical Assessments (EAD).
- ☐ In case European product standards or assessments do not apply, use Quality Assurance (for ex., ISO 9000) schemes as an additional tool.

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